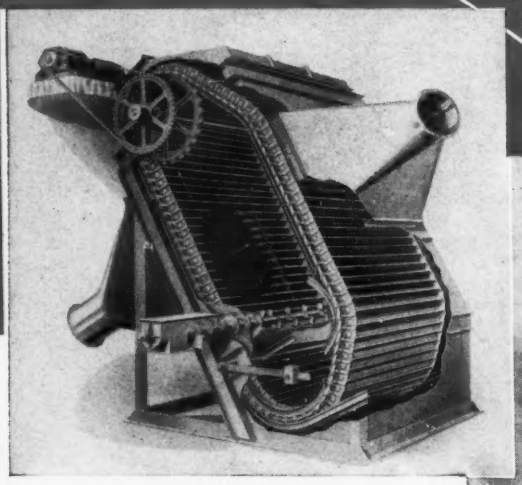
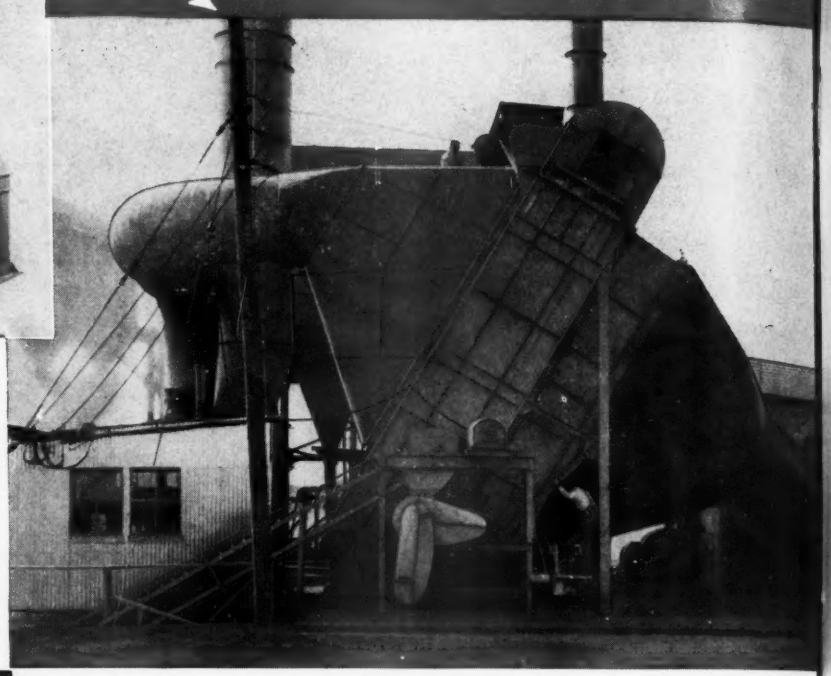
Mining CONGRESS JOURNAL

HEAT DRYING FINE COAL at a Profit!





At a Southern Illinois mine, this Link-Belt drying plant (right) was built especially to recover and convert sludge, that formerly had been wasted, into powdered fuel for utility power plants. The Multi-Louvre Dryer (above) handles 35 tons per hour, and reduces surface moisture from 12% to 1% — AT A PROFIT.

A few Typical Installations

- **SOUTHERN ILLINOIS**
  35 T.P.H. of ¼" x 0" handled in a single unit, reducing total moisture from 20% to 9%.
- **EASTERN KENTUCKY**
  Two units handle a total of 110 T.P.H. of ¼" x 0". Moisture reduced from 15% to 3%.
- **WEST VIRGINIA**
  Two units, each with a capacity of 36 T.P.H., dry ⅜" x 0" coal. Moisture reduction from 8% to 3½%.
- **EASTERN KENTUCKY**
  Two units handle 38 T.P.H. in each dryer. 16% moisture reduced to 3%.

Excellent Results on Many Types of Coal

The Multi-Louvre Dryer design permits flow of drying gases through the system at low velocities, resulting in low power requirements and minimum degradation. Often it is practical to use the fines from dust collectors as fuel for the dryer furnace.

Link-Belt engineers can be helpful in solving your drying problems — regardless of coal seam or particle size — whether for recovery of waste, or as part of new or existing plants. Ask them — and ask for Book No. 2209.

LINK-BELT COMPANY 11.639

Chicago 9, Philadelphia 40, Pittsburgh 13, Wilkes-Barre, Huntington 9, W. Va., Louisville 2, Denver 2, Kansas City 8, Mo., Cleveland 15, Indianapolis 6, Detroit 4, Birmingham 3, St. Louis 1, Seattle 4, Toronto 8.

COAL PREPARATION AND HANDLING EQUIPMENT

Engineered and Built *by* LINK-BELT

"Clean-Up" is TOUGH Work . . . but the "AUTOMAT" is built to TAKE IT!

★ In many mines you'll find the Whaley "Automat" in the tough work . . . around the clock . . . 3 shifts a day. It is in a class by itself in taking top or bottom in entries to increase height, making grades, cleaning up falls, etc. The "Automat" is the one high capacity loader that will load slate or rock equally as well as coal and do it consistently.

If you want a loader that will increase your loading time at the face as well as keep your mine in good productive condition day-in and day-out, then you need the dependable Whaley "Automat." Write today for our new Catalog 250 giving you the most graphic and complete loading machine information ever published. Myers-Whaley Co., Knoxville, Tenn.

MYERS-WHALEY

"MECHANICAL LOADERS EXCLUSIVELY FOR OVER 40 YEARS"

Repairs don't mean shut-downs with MINE CARS

It's hard to imagine a whole mine car system being 'out for repair' at one time. A mine fully equipped with mine cars doesn't face that situation. ***That's the advantage of using a 'Constant Haulage' system which is possible only with mine cars.***

Sure, there are *occasional* delays when you haul coal with mine cars. But only one easily repaired unit is delayed...only a few tons of coal are held up. The rest of the cars keep moving, and so do your cutters, loaders and processing machinery. A well-planned mine car system *insures* you against long, costly delays in production!

Let your a.c.f. Sales Representative explain what a dependable mine car system can mean to you. American Car and Foundry Company, New York · Chicago · St. Louis · Cleveland Washington · Philadelphia · San Francisco · Pittsburgh · Huntington, W. Va. · Berwick, Pa.

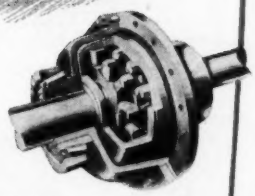
a.C.f. MINE CARS

for Constant Haulage

MACK MODEL LR...15-TON DUMP TRUCK

Keeps the Shovels HUSTLING

...Payloads Moving FAST



● Feature by feature—in every part—Mack Model LR is engineered to keep earth, rock, coal and ore moving away from the shovel—fast.

Regardless of weather or terrain, Model LR maintains positive traction through slippery mud or over uneven ground because of Mack's exclusive Power Divider differential. Power steering, air-assisted clutch, offset driver's position, proper weight distribution—all contribute to easy handling ...assure nimble maneuverability... fast, profitable hauling.

Study the standout features Model LR brings to your job. Compare them, point by point, with any other make of truck for off-highway dump work. You'll find they all add up to give you increased profits through faster time cycles and greater output at lower cost.

AMPLE HORSEPOWER: Standard engine, 196 h.p.; other engines from 150 h.p. to 306 h.p. Available in either gasoline, diesel or butane types.

MACK POWER DIVIDER: Assures good going through mud and over uneven ground by effectively transferring power to the wheel having the best traction.

MACK DUPLEX TRANSMISSION: Eight forward speeds provide a ratio range to meet the requirements of every off-highway hauling condition.

AIR-ASSISTED DOUBLE PLATE CLUTCH: Makes possible almost effortless operation; reduces driver fatigue to a minimum.

MACK PLANIDRIVE REAR AXLE: Three-pinion planetary final reduction gears located outboard of each wheel, provide large reduction without excessive size of carrier, differential or axle shafts.

POWER STEERING: Hydraulic power steering is shock-proof, positive and fast—gives easy, effortless control.

MASTERFUL AIR BRAKES: Air-actuated brakes have nearly 1000 square inches of braking area properly distributed, front and rear, to assure fast, positive and effective braking on all four wheels.

RUBBER SUSPENSION: Mack rubber Shock Insulators on front springs and rear axle support-arms eliminate twisting strains, absorb vibration, require no lubrication or adjustment, and last indefinitely.

Be Profit-Wise

MODERNIZE WITH

Mack ...outlasts them all!

Mack Trucks, Inc., Empire State Building, New York 1, New York. Factories at Allentown, Pa.; Plainfield, N. J.; New Brunswick, N. J.; Long Island City, N. Y. Factory branches and distributors in all principal cities for service and parts. In Canada: Mack Trucks of Canada, Ltd.

For heavy-duty conveyors . . .

IT'S TIMKEN...

Photo courtesy Mr. William Vandivert

1. Heavy-duty conveyors everywhere are equipped with long-lasting, trouble-free Timken® tapered roller bearings. A typical example is this West Kentucky Coal Co. conveyor. This company has 24,435 feet of conveyors, carrying over 500 tons of coal an hour. They have relied on Timken bearing equipped Webster idlers since first installing them in 1941.

AND TIMKEN...

2. On the west coast it's Timken bearings for heavy duty jobs. Here, they're used in Bodinson idlers on Pacific Coast Aggregates Company conveyors at their Fair Oaks plant. Why Timken bearings? They have extra capacity for heavy radial, thrust and combination loads. Keep idlers turning freely, reduce belt wear. Help prevent breakdowns, cut maintenance costs.

AND TIMKEN AGAIN!

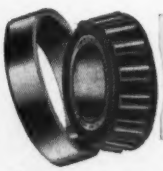
3. On the east coast, too! In Miami, Florida in 1948, the Acme Concrete Corp. installed 4 conveyors manufactured by Atlas Conveyor Company, Clintonville, Wis. The idlers roll smoothly on 456 Timken bearings—have required no maintenance to date. Wherever you go, you'll find Timken bearings are first choice. There's no other bearing with so much to offer, no other bearing so fully proved. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

WHEREVER THE GOING'S TOUGH INDUSTRY TURNS TO

TIMKEN

TRADE MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



Typical application of Timken bearings for conveyor idlers.

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◎ AND THRUST ◎ LOADS OR ANY COMBINATION

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Opinions expressed by authors within these pages are their own, and do not necessarily represent those of the American Mining Congress

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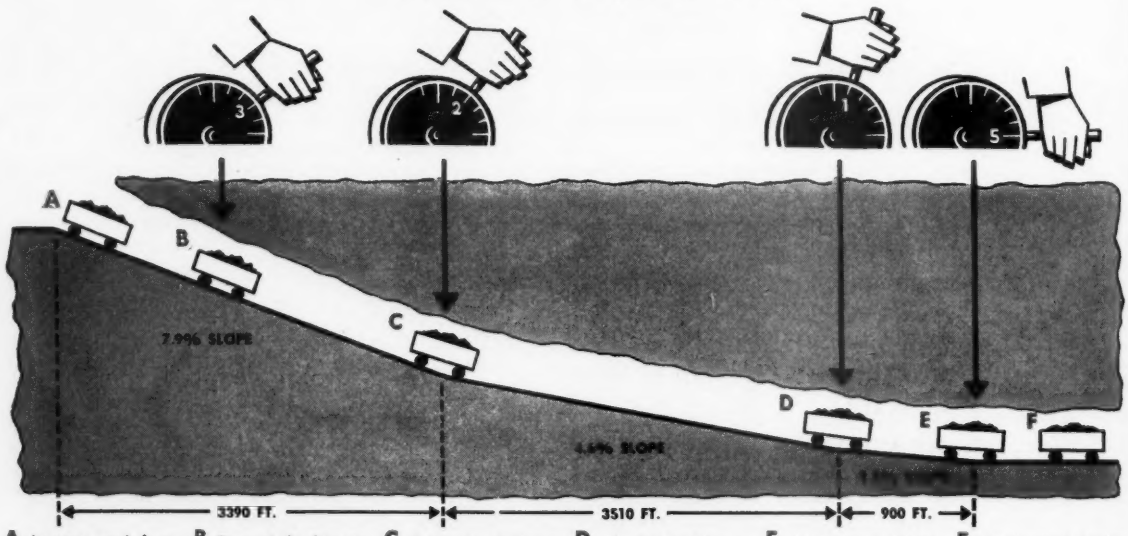
ABC
Member Audit Bureau of Circulation.

Cut brake wear!
Save spotting time!
Promote safe lowering!

HOW DYNAMIC BRAKING HOLDS THIS UNBALANCED SLOPE HOIST TO APPROXIMATELY 40% FULL SPEED



A At start, car is lowered by gravity and allowed to accelerate to 40% full speed.

B Dynamic braking is then applied in order to prevent speed increase.

C Because of slope change, only approximately 25% braking torque is required to hold speed.

D Electric braking is further decreased to about 13% to correspond with reduced pitch of track.

E At bottom, 100% braking torque is applied to decelerate to low speed for spotting.

F Mechanical brakes are applied only at end of trip to spot and hold cars.

To provide allowable man-trip speed while lowering, 40% of the full rated speed of 1200 fpm is desired over the 7800-foot length of travel. Using dynamic braking to obtain this desired speed, the operator watches his electric rope-speed indicator and simply moves his master switch to the points of braking required. Thus the speed is held in good control.

GENERAL ELECTRIC

General Electric a-c mine-hoist drive in this unbalanced-slope installation uses d-c dynamic braking control to give these advantages in reduced-speed lowering

To increase hauling capacity, the operators of a West-Central Pennsylvania mine recently installed a co-ordinated General Electric a-c mine-hoist drive. Replacing a smaller one, the new drive has boosted payload capacity to 95 tons per trip—330 tons per hour!

But that's not all! Use of d-c dynamic braking to control the hoist motor during reduced-speed lowering also provides these advantages:

Safety promoted! Lowering man-and-material trips are made at safe, uniform speeds, without jerking.

Maintenance costs cut! Mechanical brakes are used only to hold trip at its destination and for final stopping after retarding to low speed with dynamic braking—thus lessening strain and wear on brake wheels and linings.

Spotting time reduced! Control of low-speed lowering permits spotting, landing, and dropping trips into partings with minimum delay.

Economy! Simplicity! Reliability!

G-E induction-motor mine-hoist drives combine the advantages of low first cost and upkeep, simple installation and operation, high efficiency, and rugged reliability. That's why over 800 are now in service, helping to step up mine production and cut hoisting costs.

For experienced help on mine-hoist drives and other electric equipment to cut mining costs, it will pay you to call in a G-E mining specialist. Phone him at your nearest G-E office. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

Typical of hundreds of others is the G-E 800-hp wound-rotor induction motor geared to the hoist at this mine. In ratings from 50 to 3500 hp, these motors offer the simplest way to obtain the advantages of electric drive for mine hoists.

G-E control and protective equipment, located in the hoist house conveniently near motor and drum, provides full magnetic reversing d-c dynamic braking control of the hoist motor and protection of machines and power system.

The JOY *Hydraulic* ROOF BOLTING DRILL

Fastest Drilling Unit Available

for Roof Bolting

Built in 26", 30" or 36" High models

★ Performance of the JOY RBD-1 Hydraulic Roof Bolting Drill is *proved* by months of operation in the field.

★ Wherever rotary drills are applicable, it has consistently out-drilled other types—both pneumatic and electric drills—*producing as many as two-thirds more holes per shift!*

★ In practically all cases, this Drill will bottom your roof-bolting holes with only one steel change—something that *no other drill will do* except in the thickest seams.

★ The JOY Hydraulic Roof Bolting Drill is rubber-tired and self-propelled—equipped with hydraulic controls for *one-man operation.*

★ May be equipped for wet drilling—or with vacuum dust remover, as desired, *to eliminate objectionable dust.*

★ The Drill employs boom feed, and is *self-leveling* and *self-aligning* while drilling.

★ SULMET Carbide Bits and Drill Steels specially designed for the RBD-1 Drill are available.

Consult a Joy Engineer

CL8080

JOY MANUFACTURING COMPANY

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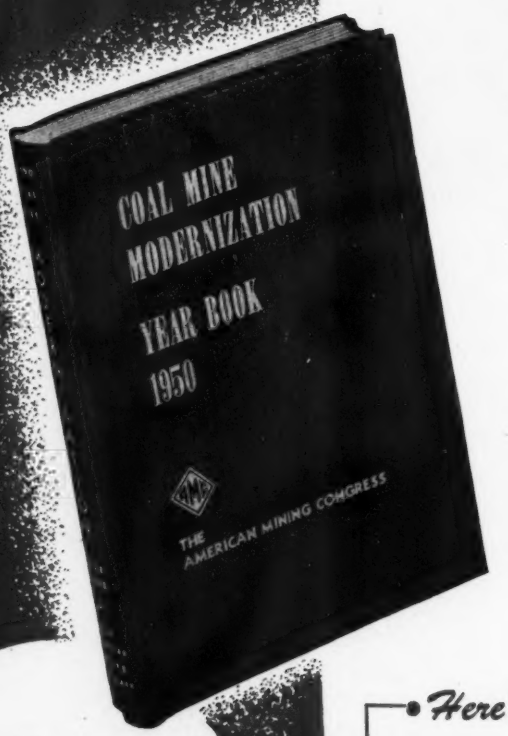
THE **1950** EDITION

COAL MINE MODERNIZATION YEAR BOOK



ALL the latest coal mining "know-how" is yours in this handy book containing the full proceedings of the 1950 Coal Convention. It's the work of more than 50 top-notch engineers and key operating men. It's crammed with time and money-saving ideas—tells you all the basic facts on new machines, new equipment, new methods—gives you the low-down on safe and efficient coal production and preparation.

The Year Book is the only publication of its kind—the national record of coal mining progress. Every key coal mining man should have one! Arranged in handy-to-use form and fully illustrated, the Year Book can be put to work again and again in helping solve everyday problems arising around the mines.

Order your copy today!

$3.00 per copy
Special Quantity Rate
10 or more copies
$2.75 each

Here's what they said about the 1949 book

"The Year Book is an excellent collection of facts and ideas on important and timely mining subjects."
Chief Engineer

★

"I find it full of interesting and valuable material. I think you are doing an outstanding service to the industry."
Vice President and General Manager

"I have searched the field for a suitable text book and find there is only one book that is suitable. That is your 'Coal Mine Modernization Year Book.'"
Professor—School of Mines

★

"I congratulate the Congress in getting out such an interesting volume."
Asst. Vice President

Published by

THE AMERICAN MINING CONGRESS
RING BUILDING WASHINGTON 6, D. C.

Why do it the hard way?

This NEW JL-4 JACKLEG makes Jackhamer drilling much FASTER and EASIER!

and increases footage up to 50% or more

Where Jackhamers are used for other than down-hole work, Ingersoll-Rand's *new* JL-4 Jackleg makes it easier for the operator—saves valuable manhours—and gives more footage per shift. The I-R Jackleg replaces muscle power with *air power*—to support the drill, feed it and absorb the recoil.

The *new* JL-4 is the result of 10 years' experience in manufacturing and applying Jacklegs. It embodies many important new developments in this type of mounting ... A 4-foot feed permits the use of longer steel changes made possible by Ingersoll-Rand Carset Jackbits... An improved roller-type pressure control valve, adjustable in 5-pound increments, gives exact and easier control of feed leg pressure... A finger-tip bleed-off button gives just the right amount of pressure release for drilling through seamy and fitchery ground... The bayonet type of connection between the drill and the Jackleg allows instant disassembly and easy transport from one location to another... Also, hardened clamping plates that hold the drill are inexpensively renewed without replacing the entire arm. The smaller JL-3 Jackleg is available when requested.

For full information, see your I-R representative.

S24-5

Ingersoll-Rand

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TANDEM DRIVE MOTOR GRADER

only

$3,585

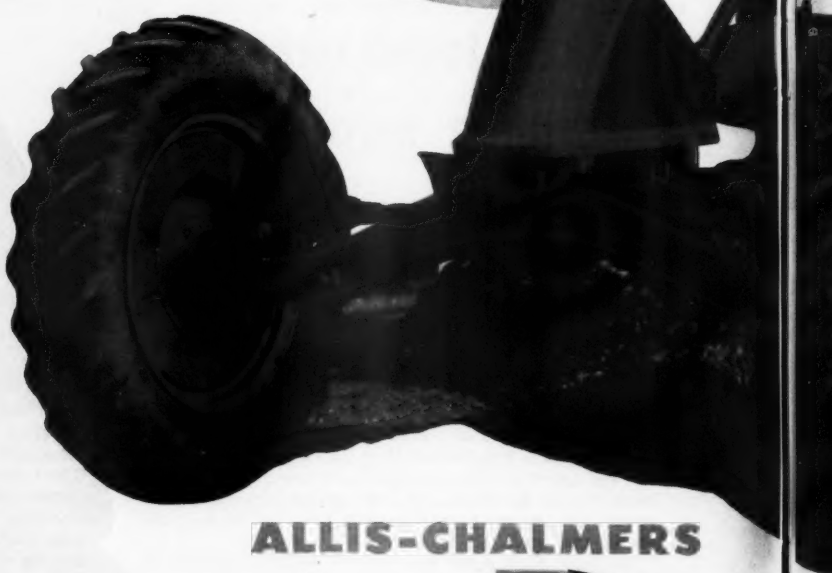
F.O.B. Springfield, Ill. Taxes, attachments and export preparation extra. Price subject to change without notice.

Here's a value that invites comparison

***Compare* THE PRICE!**
***Compare* THE FEATURES!**
***Compare* THE PERFORMANCE!**

. . . and you will agree

THE ALLIS-CHALMERS MODEL D IS YOUR BEST BUY...BY A LONG WAY



Not a converted job . . . it's ENGINEERED NEW FROM THE GROUND UP — to bring you BIG grader design and performance advantages:

- ✓ Tandem Drive
- ✓ Rear-Engine Design
- ✓ Tubular Frame
- ✓ High Arch-Type Front Axle
- ✓ Roll-Away Moldboard
- ✓ Drop Down Transmission
- ✓ Power Hydraulic Controls
- ✓ Full Visibility
- ✓ Complete Operator Comfort
- ✓ Simplified Servicing

. . . Plus special attachments that widen its usefulness — Rear-End Loader, Scarifier, Windrow Eliminator, "V" or Blade-Type Snowplows. Also, various other accessories. Electric starter and lights standard equipment.

"Seeing is Believing." Ask Your Allis-Chalmers Dealer for a Demonstration.

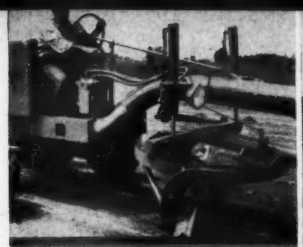
ALLIS-CHALMERS

MODEL D

WEIGHT — 8,500 lb. (bare)

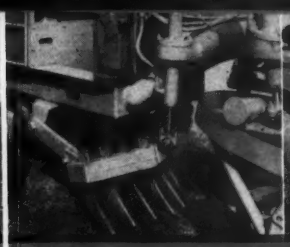
BRAKE HP. — 34.7 (famous Allis-Chalmers gasoline engine)

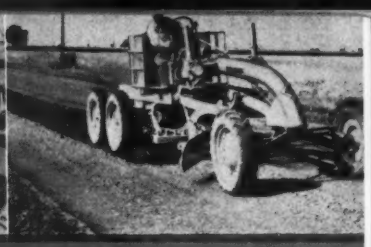
SPEEDS — four forward, 2.40 to 18.61 mph.; reverse to 2.9



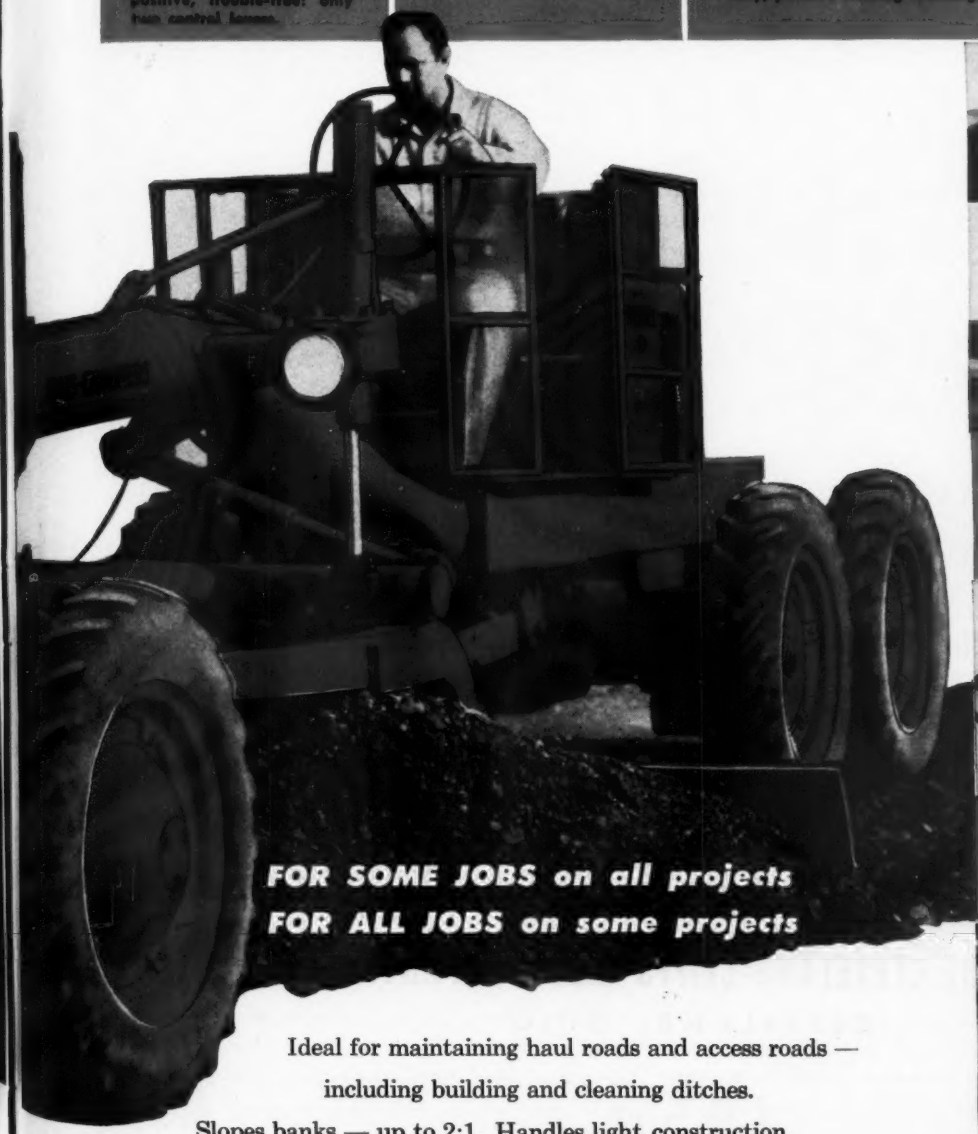
BLADE ANGLE SET FROM OPERATOR'S PLATFORM. Hydraulic blade lift—fast, positive, trouble-free: only two control levers.

ALL-VIEW CAB — quickly lifted off or replaced.

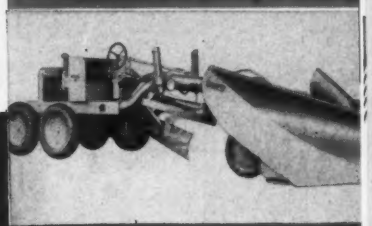




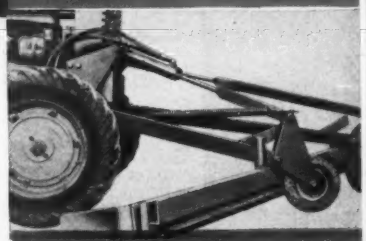
HYDRAULICALLY CONTROLLED SCARIFIER — Located back of circle for greater down pressure. Fast, accurate ripping, controlled penetration. Easy, positive steering resulting from greater front-end stability.



LOADS MATERIAL into trucks with Tractomotive Loader — from windrows or stockpiles . . . surplus dirt or snow. Hydraulically operated, simple to mount 3 cu. yd. bucket — available with bucket teeth. Note carrying position of loader—no interference with steering or blade.



PLOWS SNOW with specially designed Baker snowplows — "V" or Blade-type. Hydraulically controlled. Interchangeable blade plow may be used for backfilling and light dozer work.



WINDROW ELIMINATOR SAVES TIME. This rear blade saves extra pass by feeding out windrow from grader blade. Means safer traffic conditions, too. Specially designed for the Model D.

FOR SOME JOBS on all projects
FOR ALL JOBS on some projects

Ideal for maintaining haul roads and access roads — including building and cleaning ditches.

Slopes banks — up to 2:1. Handles light construction.

Plows snow. Loads all types of materials. Scarifies.

Does outstanding work on every job — the year around, at big savings.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

For Greater Production...For Easier Operation...For Simplified Servicing

1850

The year 1950 marks
the One Hundredth Anniversary of

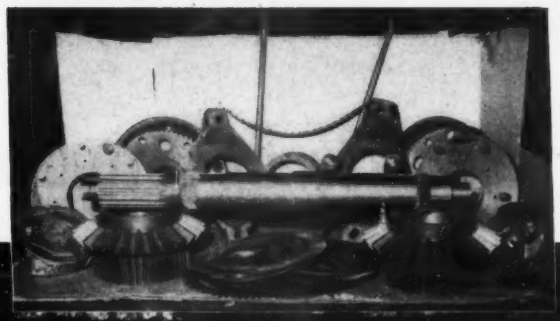
THE CLEVELAND-CLIFFS
IRON COMPANY

In entering the Second Century of our operations on the iron ore ranges in the Lake Superior District, we wish to express our deep appreciation to our employees, our customers and our shareholders for their contribution to the development of Cleveland-Cliffs during the years since the pioneering days of this company in the Iron Ore Industry.

THE CLEVELAND-CLIFFS IRON COMPANY
CLEVELAND, OHIO

1950

LESS
clutch maintenance



MORE
loader output . . .

Superla Mine Lubricants

CLUTCH REPAIRS costs down 50% . . . no delays for "warming up" loaders . . . easier and faster loading . . . these benefits have been brought to midwest mines by SUPERLA Mine Lubricants. Here's why these products will assure similar benefits for you.

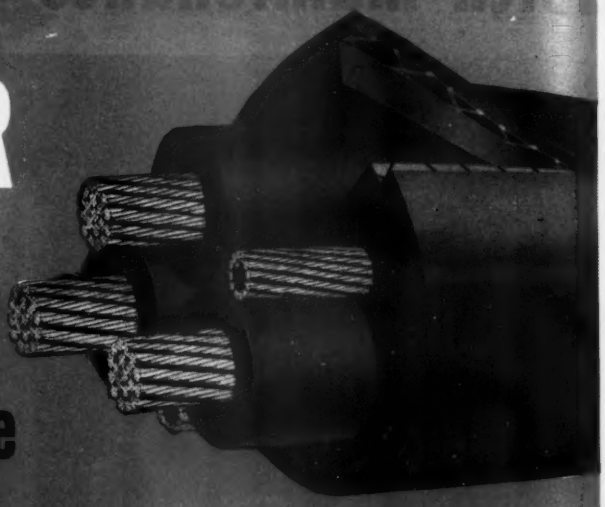
SUPERLA Mine Lubricants keep transmission cases clean. Clutches operate easily with no gumming or coking caused by oil deposits. When machines are started, these lubricants flow readily between clutch plates, protect them against wear, eliminate "clutch drag" and the necessity for warming up loaders. During long periods of continuous operation, SUPERLA Mine Lubricants do not thin out excessively, provide safer lubrication for clutch plates.

A test of SUPERLA Mine Lubricants will prove their ability to keep your loaders on the job longer with less maintenance. These products are available in oil and grease grades suitable for any type of cutter or loader. A Standard Oil Lubrication Engineer will gladly help you select the proper grades for your equipment.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD

Anaconda introduces COLD RUBBER in SECURITYFLEX 600-Volt Mine Cable



NEW INSULATING MATERIAL LENGTHENS CABLE LIFE, CUTS SERVICE FAILURES

FIRMER AND TOUGHER, cold rubber makes Securityflex* Type G 600-Volt Mine Cable still more resistant to injury by moisture, crushing and cutting. Exhaustive tests show definitely that this improvement lengthens cable life, reduces power interruptions and lessens cable maintenance, trouble and expense.

RUBBER-CORED GROUND—Securityflex Type G 600-Volt Mine Cable also provides the famous patented rubber-cored ground wire construction. The rubber core provides larger ground wire diameter, and reduces tendency of the grounding wires to cut the cable conductor insulation.

FIRM SUPPORT GIVES PROTECTION—An additional advantage of rubber coring is the cushioning support it gives every wire in each ground wire strand against displacement and damage when the cable becomes twisted.

Examine this cable. Check its construction, see its advantages. Just call your nearest Anaconda Sales Office or Anaconda Distributor. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

*Reg. U. S. Pat. Off.

The right cable for the job ANACONDA® WIRE AND CABLE

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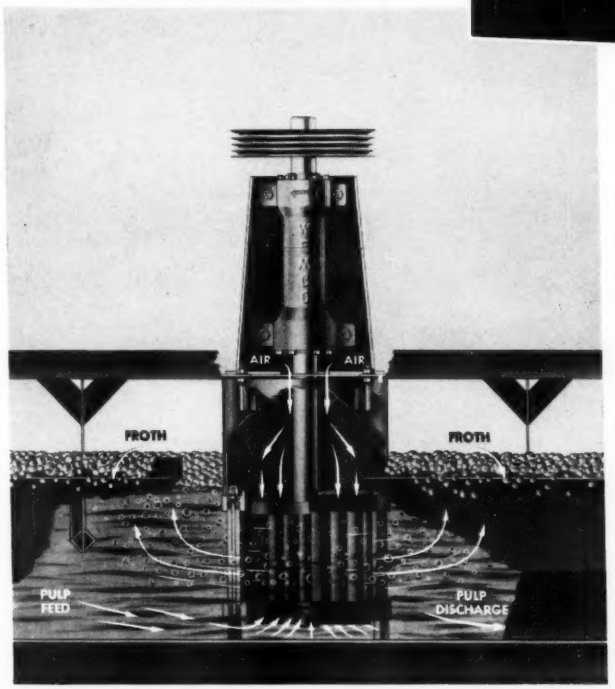

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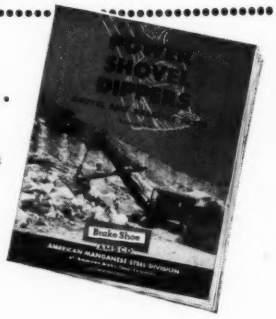

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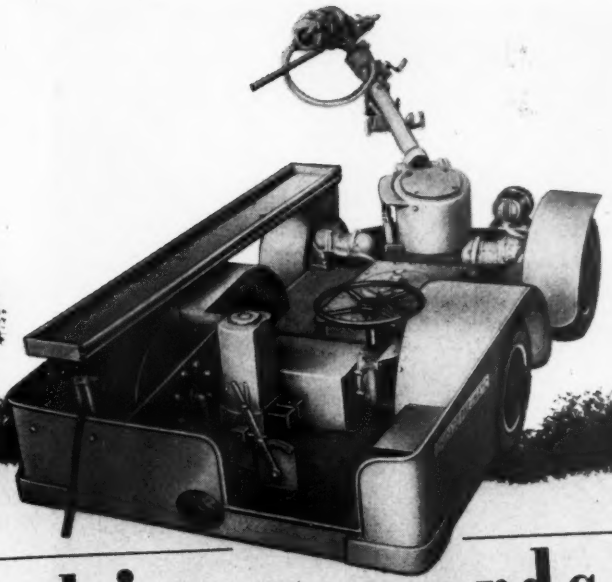

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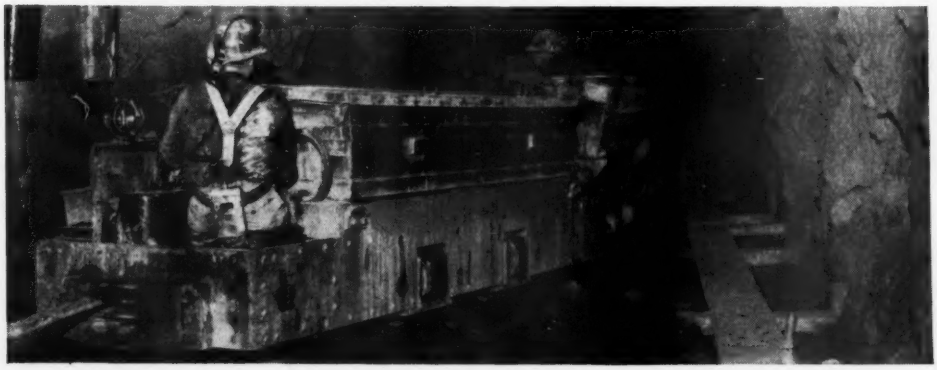

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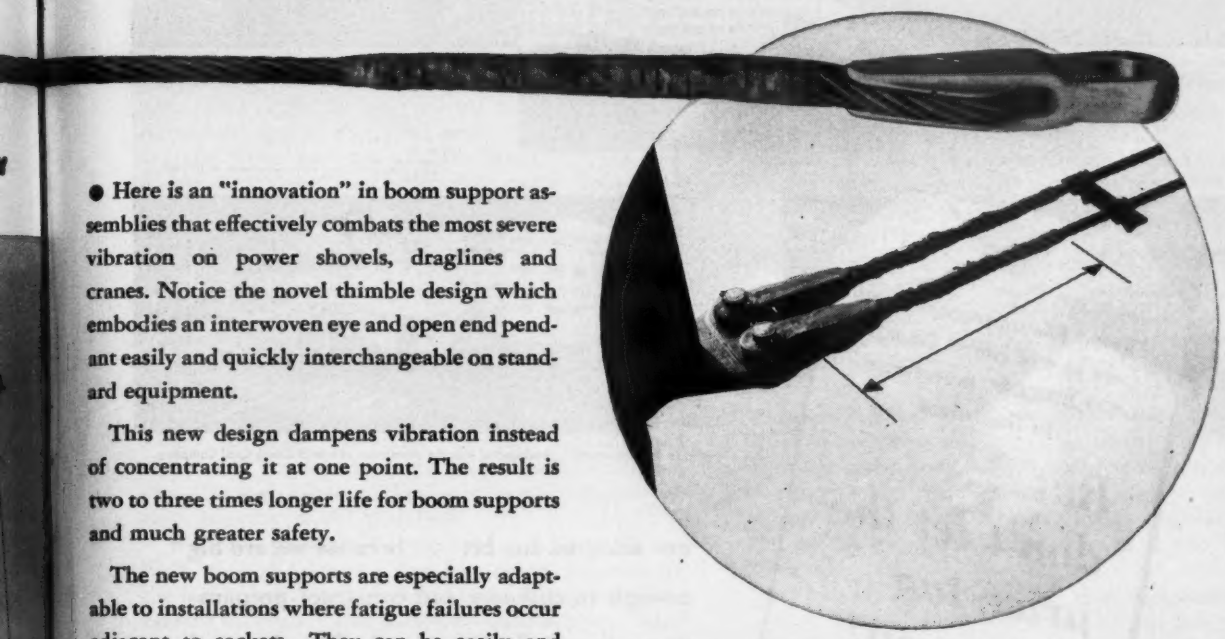

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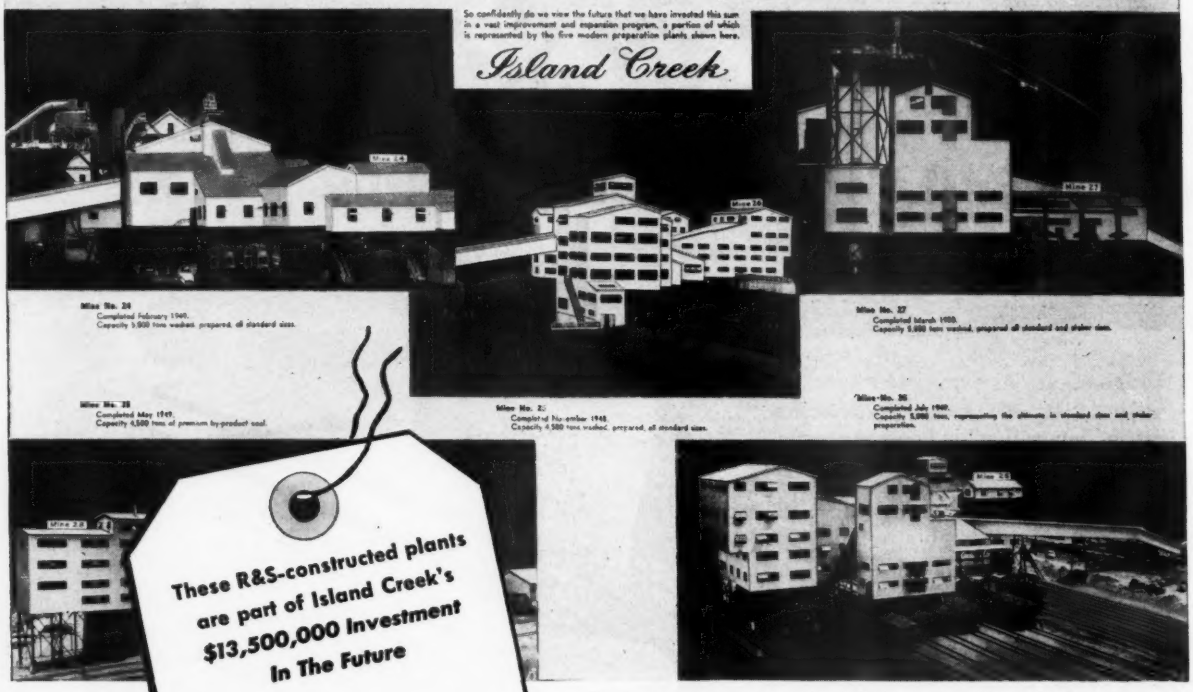
So confidently do we view the future that we have invested this sum in a vast improvement and expansion program, a portion of which is represented by the five modern preparation plants shown here.
Island Creek
These R&S-constructed plants are part of Island Creek's $13,500,000 Investment In The Future
But . . . don't let the price tag scare you!

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Editorials

SHELDON P. WIMPFEN, *Editor*

June, 1950

Technology and Taxes

GEOLOGY tells us that the dinosaur, the mammoth and other antediluvian species vanished because they were unable to change their characteristics to contend with an altered environment. However, there is no need to search the sparse records of prehistoric time to find examples of inability to cope with changed conditions because of inadequate equipment.

A look across the Atlantic reveals more than enough of sorry samples. Britain, a leader in the industrial revolution of the last century and a builder of industry, failed in its duty of re-equipping its plants when superior tools and machinery developed. British plants and factories were "tops" in efficiency at their inception. Mining methods and equipment employed in the tin mines of Cornwall and the coal mines of Wales were models for the contemporary world to follow.

With the passage of time, new and more efficient tools were developed. But by failing to re-equip, the mines and plants of Britain and Western Europe became decrepit. Technological obsolescence in those areas is now being reduced by American "know-how" and a flood of U. S. taxpayers' dollars.

At the same time that they receive this helpful bounty, many nations condemn our system and conduct costly experiments in social and economic fields. Perhaps, as Winston Churchill points out, those nations that are so quick to denounce capitalism would do well to examine closely the American political-economic system that fosters a high standard of living and also provides the wherewithal for generous foreign aid.

But the liberty inherent in the free functioning of the capitalistic system is not the point in question here, except as it has provided a salutary climate for technological advances. For the most part, domestic industry has been quick to replace obsolete equipment, whether worn out or not, where newer tools will bring increased mechanization and greater efficiency.

Both mine operators and manufacturers have cooperated to attain greater safety and the more economic production of our mineral resources. Annual conventions and expositions of mining machinery are a potent force in forwarding industrial re-equipment programs, as are the technical journals that publicize these invaluable meetings. Of special importance is the service performed in "spreading the word" of new developments, so that mine management and operating personnel may take advantage of the most efficient means of production.

In addition to the American Mining Congress, there are a number of agencies that play an important part in blazing the trail of progress. These include Bituminous Coal Research, Inc., the American Institute of Mining and Metallurgical Engineers and the research departments of our schools and colleges, in addition to a large group of independent engineers and operators. These organizations and individuals have aided industry in "plowing back" available funds in such a manner as to obtain maximum benefit from the investment. The result has been a supply of minerals and metals to meet the steadily increasing per capita demands of a growing population as well as the exceptional requirements of two World Wars.

In recent years funds for new equipment, for exploration and development, as well as for paying some measure of return to investors, have been subjected to the heavy drain of the corporate income tax and the personal income tax. Taxes, not only in their amount but in their form and the manner in which they are applied, have conspired to multiply those industrial problems soluble only by adequate capital.

Although we have come far in equipping our industries with the best in machinery and tools, these programs must be maintained and amplified in order that the mining industry be in position to meet demands for basic raw materials. If funds for essential machinery replacements are siphoned off in excessive amounts, production efficiency will decline. On the other hand, the disaster of industrial decay can be avoided by leaving in the hands of private industry the required capital to promptly utilize re-equipment opportunities. Distinct changes in present taxes and their manner of application are essential if we are to move forward to maximum productivity.

If industry is stripped of the means of developing and adopting tools of top efficiency we shall soon be in the place of those we now help. There would be but one difference—we would have no one to turn to!

At Pioche, Nev., the Caselton plant mines and mills 1000 tons of complex ore per day

How Electronics Provides Overwind Protection

A Unique System Solves a Serious Problem to Assure Safe and Positive Hoist Control

By C. M. MARQUARDT
Electronic Engineer
Combined Metals Reduction Co.

AT Caselton, Nev., all hoisting is done in balance with the skips permanently mounted below the cages. A Nordberg double-drum hoist powered by a 200-hp, wound-rotor, a c motor is manually controlled from a drum switch. Post-type hydraulic brakes are used on this hoist. Originally, provisions were made for a separate cage compartment, but this was used as a pipe compartment when an unusually heavy flow of water impeded operations. Consequently the skips were mounted permanently below the cages leaving only about ten feet of clearance between the cage bonnet and the headsheave when the skips are in dumping position.

No overwinding mishaps occurred in the operation of the shaft until production was materially increased. Thereafter, when the hoistmen had no time to relax, two serious overwinding accidents occurred within a period of several months. Another effect of the increased rate of production was a tendency on the part of some of the hoistmen to enter the dump too fast, causing cumulative damage to the skip and dumping equipment. It became readily apparent that some method was urgently required to force the operators to manually control the speed of the skip as it entered the dump.

To achieve this aim the control employed would have to be actuated by the passage of the cage itself. Any device operated from the hoist indicator dial would not provide adequate precision as the stretching of the cables would alter the settings. With the cage itself actuating the protective device, changes in the cable would be immaterial.

Analysis of the problem resulted in the conclusion that it was not practically conceivable to accomplish the task by physical contact with the cage. No switch could be found strong enough and sufficiently reliable to hold up under 200 or more actuations per day required by full-time production. Normal wear threw out the possibility of using rubbing contacts. Frequent inspection and replacement with the consequent risk of failure of the contacts was not desirable.

Electric Eye Considered

When hoisting the shift a phototube arrangement is used but experience has shown that this method of sensing the passage of the cage is not completely reliable. During the warm summer months insects obscure the light source and, on occasion, cause the device to actuate. False actuations have occurred during the winter months when falling snow has partially covered the light source. Frequent cleaning of the lens is necessary to remove dust. A more reliable means of using the cage to actuate a protective device was essential.

Many mine operations have had difficulty in preventing overwind. A wide variety of devices have been tried from time to time to provide essential protection. Here are the details of a cage-actuated apparatus to provide a safe and economic solution. The methods described are applicable to the operation of any shaft or slope.

Examination and study of the available methods led to the decision to let the passage of the cage near a coil cause a variation in impedance of the coil to unbalance an electrical bridge circuit. A Maxwell bridge is formed by the coils L_1 and L_2 and resistors R_1 and R_2, as shown in Fig. 1. A power transformer, T_1, feeds alternating current to the bridge. Inter-relation of the coils and resistors is shown by the equations:

$$L_1 R_2 = L_2 R_1$$

or

$$\frac{L_1}{L_2} = \frac{R_1}{R_2}$$

Adjustments of the values of R_1 and R_2, when the skiproad opposite the sensing coils is clear, makes it possible to balance the impedance bridge. The inductance of coils L_1 and L_2 should be as nearly equal as possible in order to obtain the best results. No voltage appears across the secondary coil or transformer T_2 when the bridge is balanced. However, when the cage passes either coil and there is a change in the impedance of L_1 or L_2, the bridge is unbalanced and an alternating voltage is induced in the secondary or transformer T_2. The voltage induced in the transformer secondary with the cage opposite L_2 is 180 deg out of phase with the voltage induced when the cage is opposite L_1.

This induction bridge arrangement offers many advantages as a means for sensing the passage of the cage. Neither insects nor weather can bother properly wound coils and the problem of protecting them from falls of rock is a simple matter. There is no wear as no physical contact is made nor are there any moving parts. Generation of the voltage impulses motivates the protective device and prevents overwind and forces the operators to govern the dumping speed manually.

Design Elements

Objectives of the protective device were as follows:

(1) The sounding of a warning whistle as the ascending cage passes the shaft collar to remind hoistmen to prevent skip from entering the dump at excessive speed. The warning whistle should not sound as the cage passes the collar in descent.

(2) Actuation of the protective device to cut off power and set the brakes should the skip enter dumping position at excessive speed. The device should not actuate when the skip is descending.

(3) Actuation of the protective device should the cage travel beyond the skip dumping position. Thus the hoistmen could not pull the cage into the headsheave either while hoisting at lower than normal speed or in the event of operating the hoist in the wrong direction.

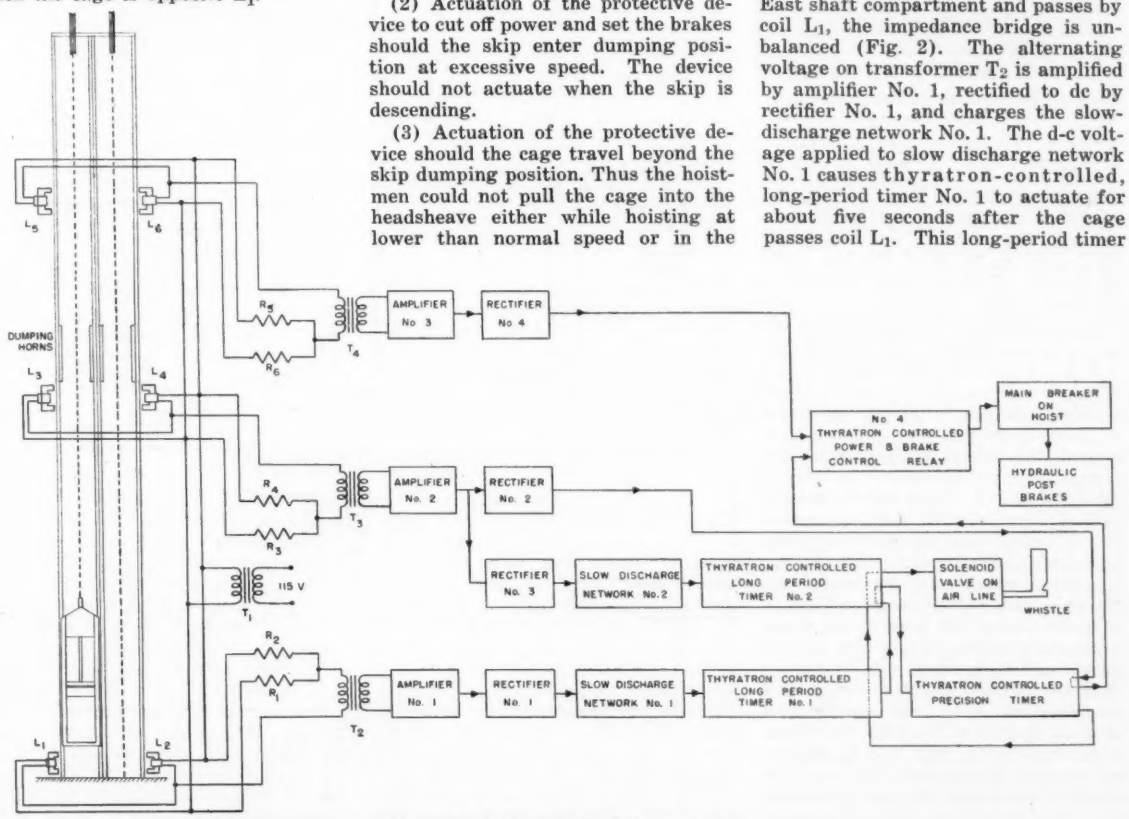
(4) Setting of the brakes and cutting off of the power in the event of failure of any portion of the device. By designing the protective device to be "fail-safe," a means of by-passing the protective device to hoist in the event of an emergency, is required.

(5) Provision of a simple means of testing the operation of the apparatus.

Interlocking relays could not be used to prevent the warning whistle from blowing on the downward trip of the cage, inasmuch as the cage is frequently stopped at the collar. Hence, it was necessary to provide for a positive sounding of the warning whistle on the ascending trip no matter where the cage was stopped, at the collar or if it moved into the dump.

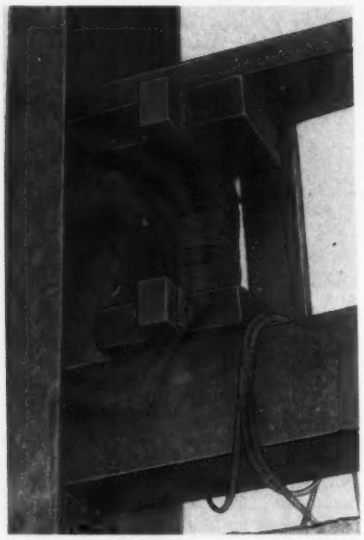
Control Operation

When the cage is ascending in the East shaft compartment and passes by coil L_1, the impedance bridge is unbalanced (Fig. 2). The alternating voltage on transformer T_2 is amplified by amplifier No. 1, rectified to dc by rectifier No. 1, and charges the slow-discharge network No. 1. The d-c voltage applied to slow discharge network No. 1 causes thyratron-controlled, long-period timer No. 1 to actuate for about five seconds after the cage passes coil L_1. This long-period timer



Electronic circuit controls hoist operation

controls a second thyratron-controlled timer called the precision timer. This latter unit precisely measures time intervals to an accuracy of plus or minus 0.01 seconds. This may be accomplished over any preset time interval of less than five seconds. The shrill warning whistle is actuated by the precision timer which also alters the grid connection of thyratron No. 4 from a positive source of voltage to rectifier No. 2 which is associated with coil L_3. The coil of the final power and brake control relay is energized by thyratron No. 4. Coil L_3 is located



Current induced in coil actuates control device

just below the dumping position in the headframe. On the completion of the timing cycle of the precision timer, it switches the grid of thyratron No. 4 back to the source of positive voltage to insure the firing of the No. 4 thyratron at all times when the cage is not near coil L_3.

When the cage passes coil L_3, the signal emitted is amplified by amplifier No. 2 and rectifiers Nos. 2 and 3. These rectifiers put out a negative voltage relative to ground potential. If hoist speed has been properly controlled, the precision timer will have completed its cycle before the cage is opposite coil L_3. This disconnects the grid of thyratron No. 4 from rectifier No. 2 before the signal from L_3 is generated, and thyratron No. 4 does not cease firing and the brake and power control relay is not actuated.

In the event that cage speed is not properly controlled from the time it passes coil L_1 until it reaches coil L_3, then the precision timer, not having completed its cycle, will connect the grid of thyratron No. 4 to the output of rectifier No. 2. The voltage applied to the grid of thyratron No. 4 is the rectified and amplified signal from coil L_3. This thyratron ceases to conduct and de-energizes the power and brake control to stop the hoist immediately.

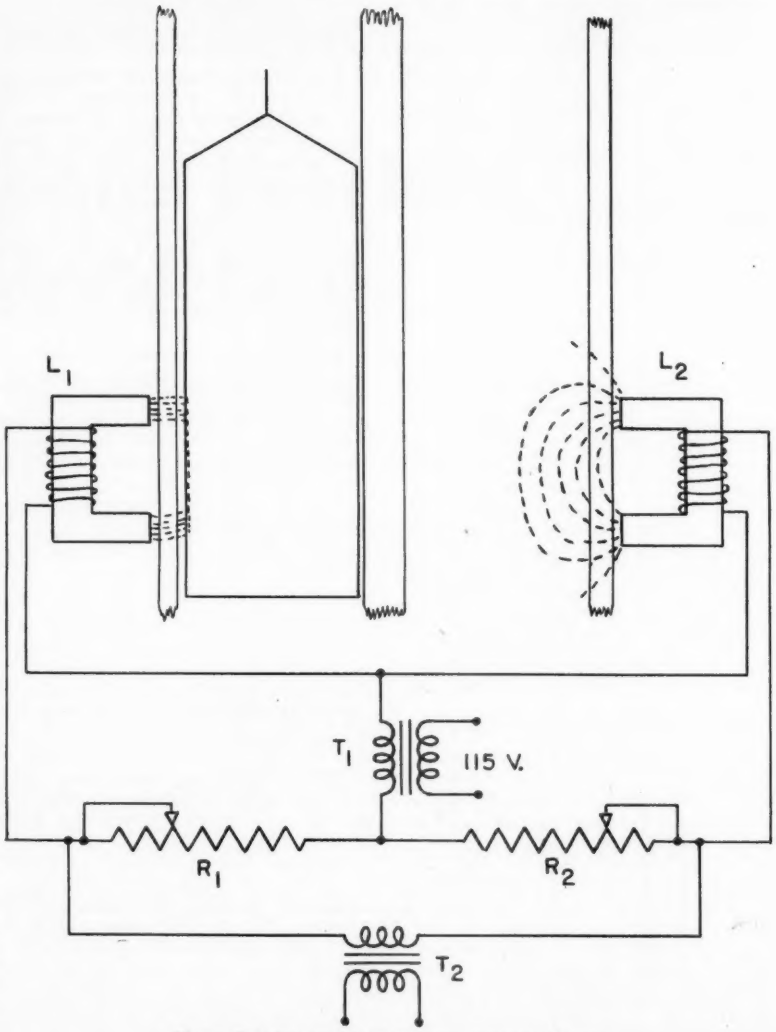
As rectifier No. 2 output is not fed to a slow discharge network, when the cage passes coil L_3, thyratron No. 4 ceases to fire. The hoistman may regain control of the power and brakes and the final control relay resets itself.

When the cage passes coil L_3 in descending, a signal is sent to rectifiers Nos. 2 and 3. As the precision timer has run down, rectifier No. 2 output does not affect thyratron No. 4, but output from rectifier No. 3 is fed to a slow-discharge network which is charged to a high negative potential, causing thyratron-controlled, long-period timer No. 2 to actuate for a period of about ten seconds. Thus, the circuit to the precision timer is open to prevent it from going through the timing cycle for these ten seconds. On its downward trip, when the cage passes L_1, long-period timer No. 1 is actuated but cannot start the precision timer, therefore, the whistle cannot blow on the downward trip of the cage.

Both long-period timers have completed their timing cycle on the passage of ten seconds and the apparatus is ready for another upward trip. Inasmuch as it is practically impossible to stop and reverse the hoist in this brief period of time, the device is a practical guarantee of ever present overwind protection.

Coils L_5 and L_6 prevent the cage from going too high in the headframe at a reduced speed or from being "backed" into the sheave by operating the hoist in the wrong direction. If the skip passes these coils, the main power breaker opens up and the brakes are set. The inertia of the hoist cannot carry the cage into the sheave when the power is cut off and the brakes are applied inasmuch as the cage is unable to pass the dump except at reduced speed.

Similarly, the operation of the cage in the West compartment causes the



Maxwell induction bridge senses passage of cage

Sensing coil, uncovered, is of rugged construction

protective device to function in the manner described.

"Fail-Safe" Considerations

The safety of the device to set the brakes and cut off power in the event of a failure of some component was a serious consideration in the design and construction of the apparatus. To meet this objective the tubes in the electronic circuit were selected with filaments that would require the same current and all filaments were connected in series so that the failure of one would open all filament circuits to cause a complete shutdown.

All tubes are operated below normal rating and the tubes were selected of the twin-triode type with one-half of each section applied to one portion of the circuit and the other half to another portion of the circuit. The grid and anode circuits of all tubes are paralleled as a further assurance against failure. These conservative conditions of operations together with a parallel tube arrangement should result in a tube life of many years. Occasional testing of the tubes is a further guarantee against the tube failure while in normal operation.

Thyratron tubes operate all timers to prevent relay chatter and assure sharp operation. Timer circuits are designed with thyratron tubes normally conducting and the relays have their coils normally energized. Thus, failure of coil or thyratron causes the brakes to be set and the power to be shut off. These extreme precautions were taken as it was felt that the hoistmen would soon become accustomed to the shrill warning whistle and would unconsciously depend upon it to signal them when the cage had passed the collar.

To make sure that the component parts of the apparatus were operating properly, a test switch connected with the precision timer was installed. When thrown to the "test" position, the timer cycle is lengthened to allow the cage to be pulled past the lower and upper coils to test for proper setting of the brakes. After installation of the protective apparatus, precision timer was adjusted when hoisting was normal to assure that the cage would enter dumping position at the required rate of speed without causing the protective device to be actuated.

A less experienced hoistman, who had the habit of pulling into the dumping horns at too high a speed, was observed on the first day of hoisting after installation of the protective device. In the first hour of hoisting the brakes were set five times by the apparatus. In the second hour the brakes were set once and after that no difficulty was experienced. Actuation of the device is so annoying to the hoistmen that he quickly learns to reduce hoist speed to a point below the preset maximum. No hoisting capacity is lost inasmuch as the difference between passing the coils at full speed and at the desired speed is only about 0.4 seconds. Actually, increased hoisting capacity results as the protection of the device frees the hoistman from any fear of damaging the skips and dumping structures.

In addition to the Maxwell bridge circuit, the Wein bridge circuit could also be used in which a single sensing coil in each of the three locations in the headframe would do the job. In the case of the system described, the cost was approximately $850. This total included the research that went into the development of the unit. The conventional control system to obtain the same results would have cost considerably more. This apparatus could be applied to an eddy-current brake on the hoisting motor to achieve a uniform deceleration rate. Actually, completely automatic hoist operation would be possible at a fraction of the cost of a conventional automatic hoisting system. There is no limitation to the application of this device. It would serve equally well to control hoisting operations on inclines or sub-shafts.

In the application of the method to provide an automatic and foolproof derail system for slopes, there would be no need for manual electrical switches or extensive wiring back to the hoist dial. By simply setting the device in such a manner that upward trips cause the derail switch to close, downward trips at normal speeds cause the derail to also close, but runaway trips would not cause the normally-open derail to close.

Monetary Problems

Frank Lilly, consulting engineer, speaking before a recent public forum held in Spokane, declared that all of the major problems may be resolved into monetary problems.

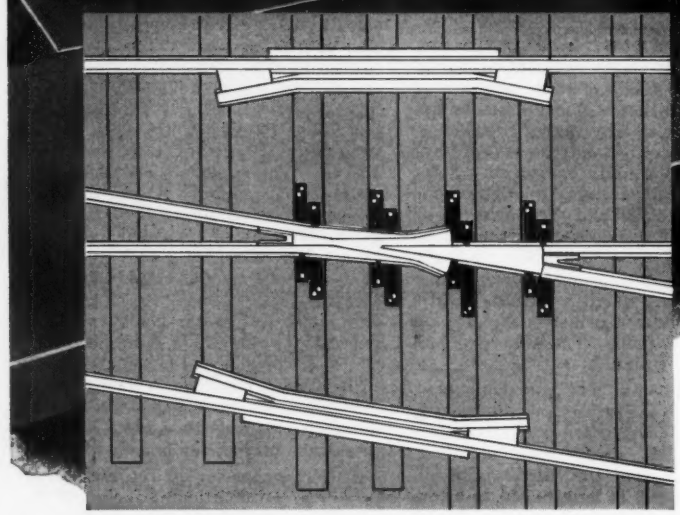
Looking back into history, Mr. Lilly recalled the great nations of the past, including Greece, Assyria and Babylonia. In each case he pointed out where the nations thrived up to the point where the wars they waged finally plunged them into destroying debt. "Debt," he stated, "is one of the greatest negative forces in the world. It . . . enslaves men and brings decay to civilizations and death to nations."

Looking at the debt situation today, it was pointed out that most of the nations of the world are in debt and that the United States is deeper in debt, relatively, than any other nation. Today's debt is over 255 billion dollars and 250 times as great as the debt was in 1914. The national debt of the United States far exceeds the total assessed value of all the taxable property in this country. The per capita debt is approximately $1,700.

How we got into this "shell" of debt was cited as primarily due to our deviation from the monetary provisions of the United States Constitution that U. S. money should be gold and silver coins.

In answer to the problem, Mr. Lilly declared that 41 different countries have, by devaluation, increased the measure of gold in their currencies in order to get more gold into their monetary systems. It was shown that there are only the two methods out of the present situation; (1) ultimate repudiation or (2) a realistic revaluation of gold at a figure that will give it the larger measure of value needed to provide an honest monetary system based on hard money.

Why put up with Loose Frogs?



Four pairs of plates, each pair at a different tie position. Yet all eight plates are the same standard length, with the same punching.

No need to!... Bethlehem's Hook Frog Plates anchor the frog securely, stiffen the track at a vital point.

Here's good medicine for loose frogs and bad alignment. It's the Bethlehem plate with the integral forged hook that fits snugly over the frog base to prevent lateral movement.

The plates are used in pairs, never alone. Each is drawn up until a tight fit results; then spikes are driven into the tie through the punched spike holes. The hooks of every pair oppose each other . . . hence equal, balanced holding forces keep the frog rigidly in place.

OTHER GOOD POINTS: These Bethlehem plates prevent cast frogs from cutting wood ties, thereby increasing tie life. They give a smoother bearing surface; raise the frog to the same height as the stock rails.

And finally—you can use the plates at several *different* tie positions. The one size is suitable for practically any frog used in mine track. There's no need to keep a large and confusing variety of plates, one size for every tie position.

Ask for more details—or better yet, let us demonstrate this helpful device. A Bethlehem man will be glad to give you the full story.

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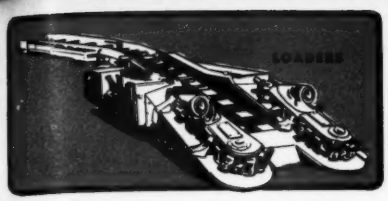
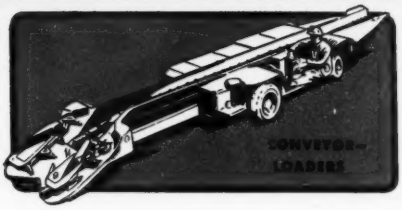
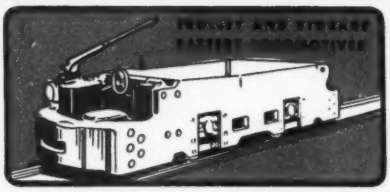
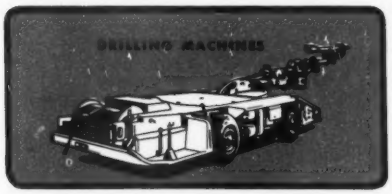


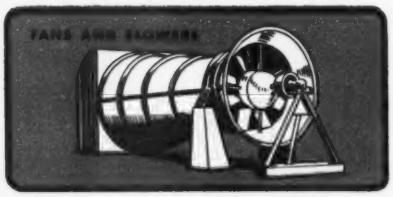


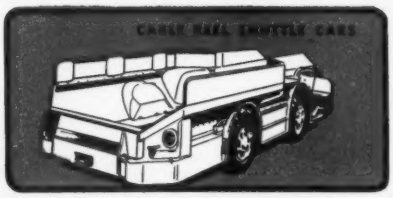


JEFFREY

EQUIPMENT FOR COAL MINES







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Established 1877

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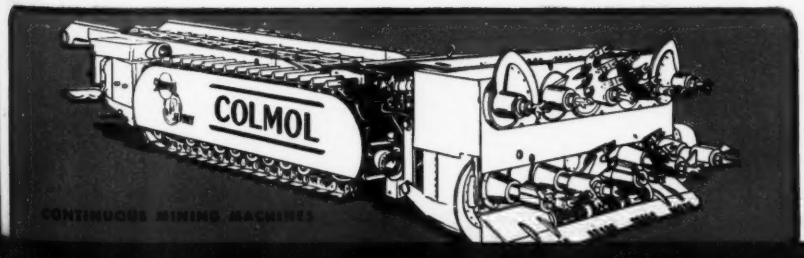
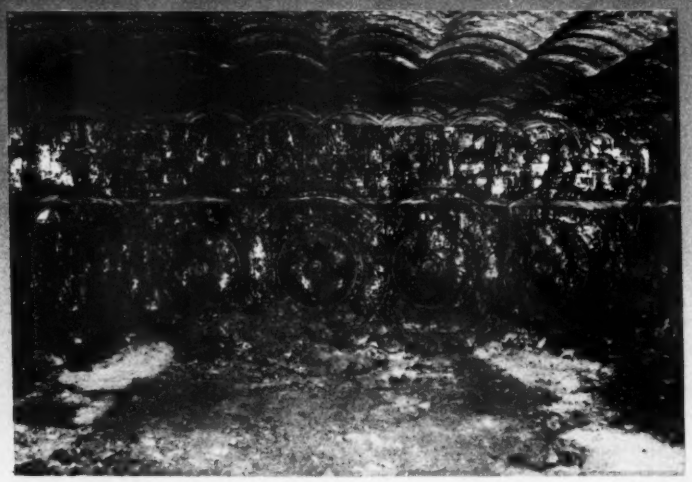
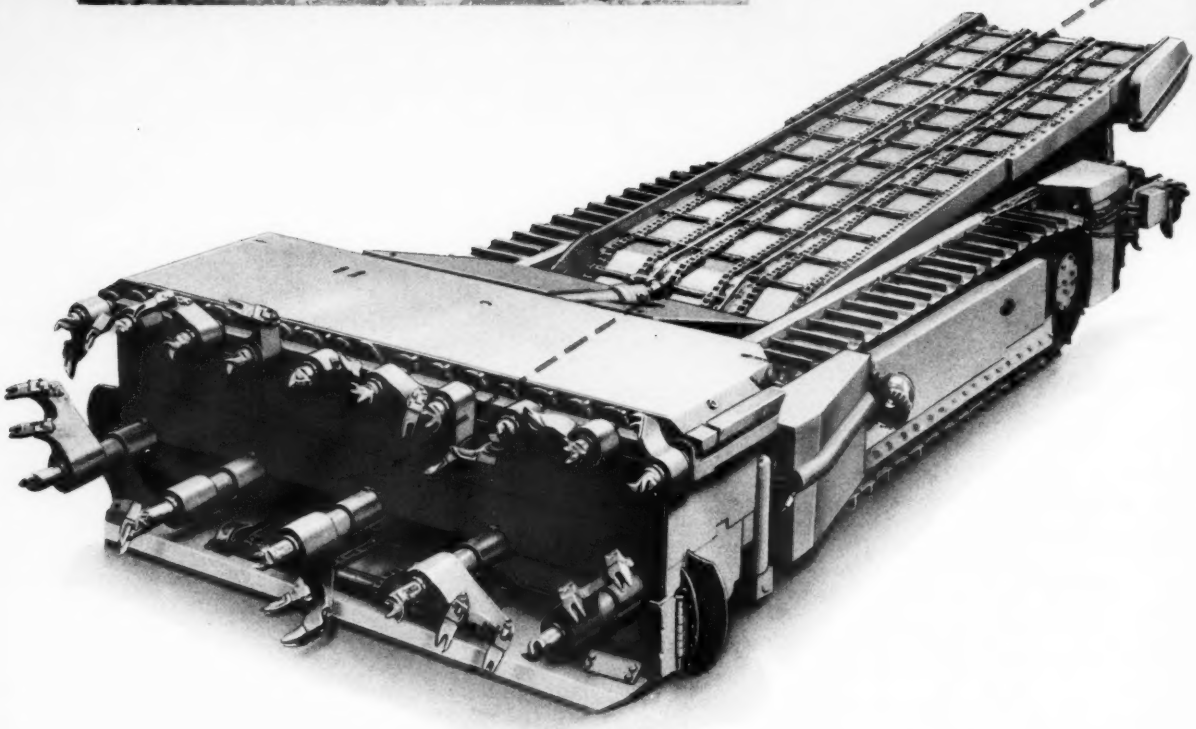


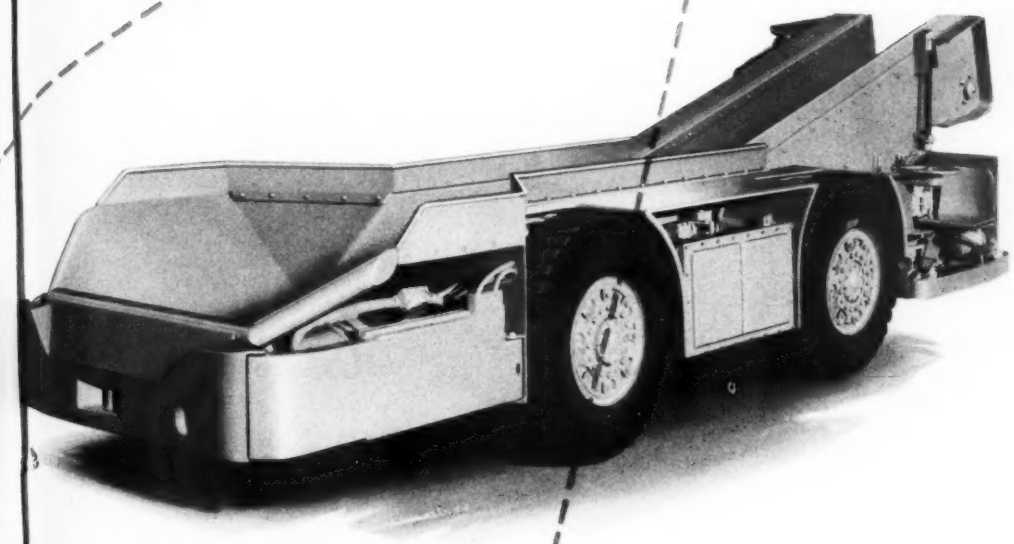
COLMOL TO . . . SHU



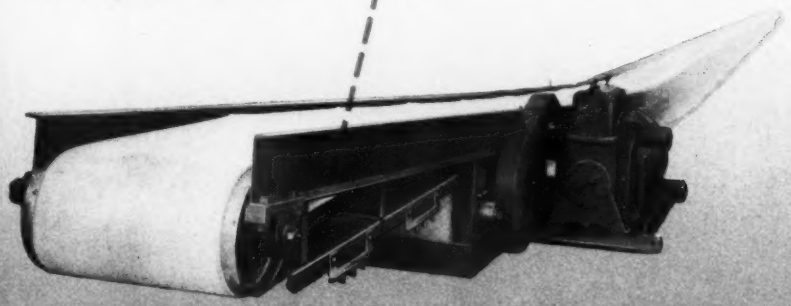


View at top of page shows the mining action of the COLMOL breaker arms as they contact the face. Also note the clean, uniform walls, floor and roof. Outlined view shows the low-type COLMOL with its conveyor elevated for loading into Shuttle Car. The COLMOL advances the face in one operation — moves forward under own power — produces a minimum of fines with greatly reduced dust hazard. This low-type unit provides a cutting width of 9'6" into seams from 30" and up. Conveyor is 42" wide — will raise to maximum height of 50", allowing 38" clearance for Shuttle Car.

HUTTLE CAR TO . . . SECTIONAL BELT CONVEYOR

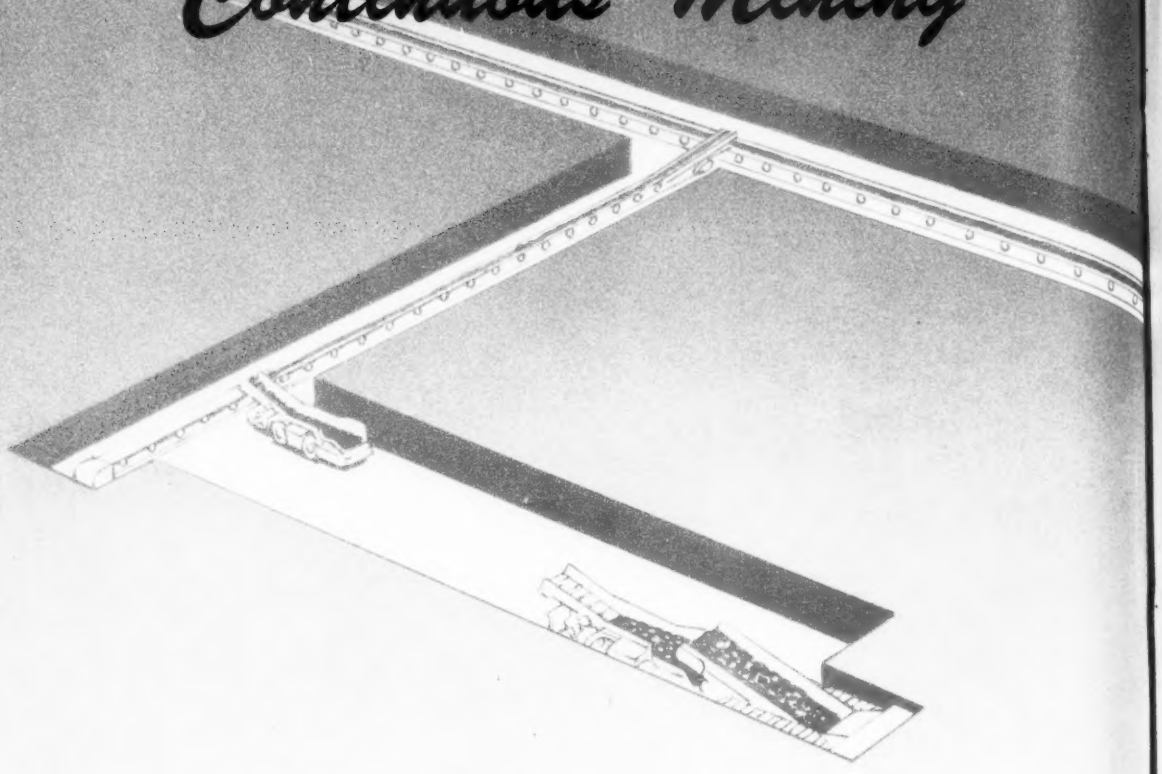


The success of continuous mining operations depends a great deal upon the means used to get the coal away once it is broken down. That is where Shuttle Cars and Sectional Belt Conveyors enter the picture . . they can handle large tonnages quickly and speed coal on its way without interrupting production schedules. A 43" high Shuttle Car is shown above — it has elevating discharge. Also 29" and 35" high Cars — capacities vary from 3.20 tons up to 7.75 tons.



Single pulley and Tandem Drive Sectional Belt Conveyors in widths 26", 30", 36" and 42"—capacities up to 18 tons per minute.

A Triple Play In Continuous Mining



Play Ball! A great team is in the field — eager to match strength against high production costs — ready to knock out tonnage at the rate of 3 to 5 tons per minute. As drawing indicates this team is made up of the one-process device — the COLMOL; one or more Shuttle Cars; and a Chain or Belt Conveyor (or both). No pinch hitters needed and that means Cutting, Drilling, Shooting and Loading sit on the bench while the BIG THREE is in there pitching (every minute). The game is on . . it's not too late to get your ticket for a ride on the continuous-mining train and see for yourself

A GREAT ADVANCE IN MECHANIZATION

Progress Report on Continuous Mining

Tests and Experiments of BCR's Mining Development Committee have Resulted in Approval of a Design for a Continuous Mining Machine

By GLENN B. SOUTHWARD

Mechanization Engineer
American Mining Congress

A PROGRESS report, summarizing the work done toward the development of a continuous mining machine has been released by the Mining Development Committee of Bituminous Coal Research, Inc. Starting in February 1949, with the establishment of a headquarters building in Huntington, W. Va., containing office, drafting room and machine shop, an intensive series of tests—underground and in the shop—have been carried on by the BCR staff of technicians. These men were ably assisted by members of the committee and advisory groups and have also had the cooperation of various manufacturers of mining machinery.

Although the main purpose of the Committee is to design and develop a continuous mining machine, in the tests and experiments made over the past year the exact form which this machine will take has really been an item of secondary consideration. In the foregoing statement, the term "secondary" is used to express a numerical order rather than a degree of importance. That is to say, the study was scheduled to proceed in a logical manner, taking first things first and before starting an actual design, to begin by determining whether it was within the range of practicability for any machine to meet or approach the specifications which had been originally set up by the committee.

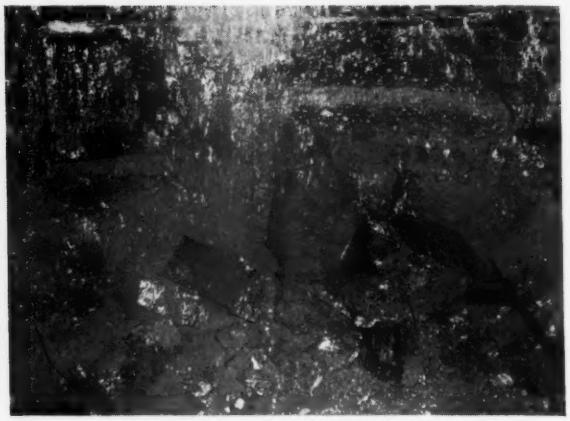
Fig. 1—Experimental horizontal cutter disk mounted on universal shaft

These original specifications were based on the definition that "continuity in mining is the ability to advance or retreat a working place without interruption or without the necessity of moving from one working face to another." As a further specification, "the machine was to be designed to work in seams as low as 28 in. and should have sufficient flexibility to operate under existing room and pillar mining systems; driving entries, rooms, crosscuts and removing pillars without the use of auxiliary cutting and drilling equipment." An additional requirement was that the machine should be able "to mine around a corner on a 25 ft center line radius, to work a place 14-15 ft wide, to retract to a 10 ft width for tramming, and to have a minimum of 4-in. clearance over and under the machine." Some of the original specifications incidentally were altered from time to time as various questions arose and were interpreted by the advisory group, but those quoted above remained on the agenda.

The decision of the Committee to consider only the room and pillar system is based on sound reasoning. Although it is recognized that long wall, or long faces, offer attractive possibilities for continuous operation, nevertheless the cost of providing adequate roof support by any method so far devised, places long wall beyond the economic limits for coal mining in the United States, at least for the immediate future. The room and pillar system, however, with its numerous possible variations has proven adaptable and economical for the coal seams of this country. The committee therefore felt that time, money and effort should not be spent in attempting to perfect new mining plans outside the boundaries of present established practices.

Tests Prove Practicability

To meet the desired requirements for size consist, and particularly for power economy, it was believed that a wedging or breaking action should be fundamental in the machine design, with cutting by bits, augers or other devices, kept to a minimum and only employed as accessory to the wedge. With this objective, a long series of experiments, that have recently been concluded, were conducted to determine what forces would be required to break coal out of a solid face and what stresses would have to be met by a machine designed to perform such operation. With the diversity in thickness, structure, impurities and other physical characteristics that exist in the coal seams of the United States, it



Figs. 2 and 3—Solid coal broken by hydraulic ram after horizontal face cuts were made

can easily be understood why more than 100 tests underground were needed to determine maximum and minimum values for all the factors that must be incorporated in any machine that was to have a wide range of application.

The tests above referred to were performed in three basic stages. First, was to determine the static force needed to break or wedge coal out of a solid face; second was to determine the dynamic force needed for this operation, translated in terms of power. The third was to combine the two actions of cutting and wedging into a single operation and again to determine forces and strains to be overcome and power needed in performing both operations simultaneously.

Without going into details as to how the conclusions were reached, it can be stated definitely that the committee believes the tests and studies have proven it to be entirely within the range of practical machine operation to combine cutting and wedging as a means for breaking coal out of a solid face. In addition, it has demonstrated that the volume of the cuttings can be small in proportion to the total volume of coal that can be wedged out after the preparatory kerfs had been made. Calculations of the power requirements, and the size consist of the product, in the opinion of the committee, definitely indicate the possibility of building a machine that will be within the limits of economic operation.

It should be stated at this point that the wedge idea was not conceived by the committee. Over the years, there have been numerous attempts and devices designed to break down coal without blasting, but none of these have come into general use. As a matter of further interest, a wedge was incorporated as a part of a mining machine designed in the early 1920's by Joseph F. Joy, but no records are available to show that the machine was manufactured commercially.

Trials and Experiments

It is not possible here to give complete accounts of how all of the foregoing tests were made, but a brief outline will serve to show how thoroughly and logically the committee has conducted the investigations. The determination of the static force needed to wedge coal out of a solid face was made with a hydraulic jack and pressure gauge. Top and bottom horizontal slots were cut in the coal face and coal was wedged down by placing the ram in the top slot with the bottom providing the "loose end."

The hydraulic pressures, as well as the travel of the ram, was carefully recorded and from these data, the basic forces which ultimately dictate strength and horsepower of the final machine were calculated. The effect of impurities was given special attention, but in no case were these found to be an insurmountable difficulty. Naturally the breaking stresses varied in the different seams and it is interesting to note that the easiest coal to break was found near Indiana, Pa., and the toughest near Ellsworth, Pa. The difference in force required between these two extremes was almost 100 times.

Following the static tests utilizing the rams, Unit No. 1 was constructed. This was merely a special gear reduction box mounted on a 29-U universal cutting machine. Its method of removing the coal from seams by wedging principles is illustrated in Fig. 1, wherein two horizontal rotors are mounted with a wedge on the top rotor breaking the coal down into the slot cut by the bottom rotor. (Figs. 2 and 3.) The vertical distance between the top and bottom disks is approximately 48 in. This application is of particular importance in seams having banded impurities and is still under development.

Fig. 4—Test Unit No. 1—Experimental vertical cutter

Fig. 5—Test Unit No. 1—Coalburster subsequently mounted on shaft with cutter arms shown in Fig. 4

Cutting and Wedging Proven Practicable

Test Unit No. 1 was constructed to permit the application of vertical rotors. This unit, as shown in Fig. 4, is 6 ft in diameter and consists of two arms at right angles, each equipped with cutting bits, and at the center is mounted a tapered wedge with a drill bit at the point. As the arms revolve, the bits cut a circle 2 in. wide on a 72 in. diameter, and as the bits advance into the face, the tapered wedge on the center shaft follows behind, breaking out the solid coal between the center and the periphery of the cut. This means that a circular kerf about 2 in. wide and 6 ft in diameter is the only part of the face that is cut; all the coal within this circle is broken out by the action of the wedge.

The cutting arms are shown in action in Fig. 4. The wedge, officially called the "burster" is mounted on the cutter bar as shown in Fig. 5, in this view, the cutter arms are not assembled on the shaft, as the photograph was taken when a special test was being run to determine the power needed to operate the wedge. The "burster" is approximately 18 in. high, and is 10 in. in diameter at its base or widest point. In its operation, the spiral screw threads behind the drill bit point serve to break the solid coal and also draw the broken pieces back out of the hole, in the same manner as the spirals on an auger, and by so doing prevent the wedge from binding. It is worth mentioning that only in rare instances has it been necessary to advance the burster to its complete depth—generally the coal breaks out when about one-half of the length has come into play.

Final Test Conclusive

This demonstration by Test Unit No. 1 proved to the committee the practicability of simultaneous cutting and wedging and the power readings on the machine evidenced economy. It was also felt that the tests had demonstrated that vertical rotors would be considerably more efficient than the horizontal type so the final step necessary was to determine if multiple vertical rotors could be designed into a machine that would meet the Committee's specifications. The McKinlay Entrydriver was selected to make this test and was modified accordingly.

This machine, as is well known, has been successfully operated for more than 20 years in the Illinois mines of the Chicago, Wilmington and Franklin Coal Co. Its mining element consists of two rotating arms each about 7 ft in diameter and equipped with specially designed cutting bits; these bits are spaced at 14-in. intervals, measuring from the center to the outside of the arm so that in rotating, a series of concentric circles are cut in the coal face. As the machine advances, the solid coal is cut from the face in two overlapping 7-ft circles, driving an entry about 12 ft wide. The standard cutting pattern is shown in Fig. 6.

In the test made by the committee, the spiral wedge or "burster" previously described, was mounted on each shaft at the center of the cutting arms and the bits removed except those in the outer ring. This meant that two circular kerfs, each about 2 in. wide and 7 ft in diameter, was the only cut made; the pattern is shown in Fig. 6. The test demonstrated the practicability of multiple rotors for cutting and wedging solid coal and the power readings, taken during the run, evidenced the operating economy of the method.

The committee has approved the progress made and has authorized construction of a demonstration machine, to be known as Test Unit No. 2 which is already well under way in the Huntington shop. This will essentially be a low type design with cutting range of from 28 to 38 in. high. The head will mine a 10 ft width, retracting to 7 ft for tramming or moving out of a place. (The final machine will cut 14 ft wide and retract to 10 ft.) However, the Committee desires to state that, although satisfactory progress has been made, it will be at least two years before a machine based on the experimental work will be ready for commercial production.

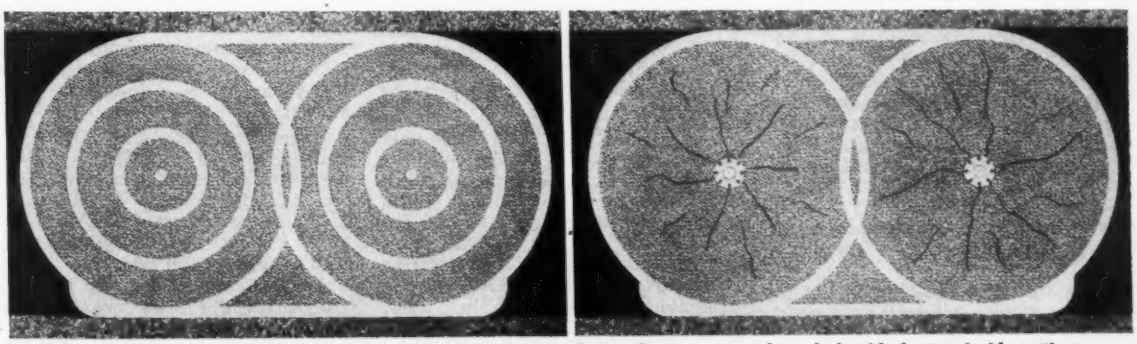


Fig. 6—Cutting Patterns—Left—Regular McKinlay face cut Right—Burster mounted on shaft with the two inside cutting rings removed

Six blast furnaces produce iron from Alabama ores at the Ensley works of Tennessee Coal, Iron and Railroad Co.

The Beneficiation of Southern Iron Ores*

Part II of a Concise Survey of the Metallurgical Means of Extending the Reserves of the Birmingham District

By E. H. ROSE

Research Engineer
Tennessee Coal, Iron and Railroad Company

For strongly magnetic minerals, magnetic separation is the cheapest and most effective beneficiation method known for the several reasons that (1) it applies a strong positive force to the magnetic mineral and none to the non-magnetic minerals from which it is being separated; (2) specific gravity of the minerals is essentially immaterial; (3) the operation is not affected adversely by ordinary variations in feed grade, size, density or particle shape; (4) close sizing of feed is not required and with proper provisions a mixture containing even micron sizes can be handled; (5) no reagent expense is involved, such as in flotation; (6) the concentrate is produced at high density, so that it need not be thickened; and (7) separation units are of large capacity and low in maintenance and operating cost.

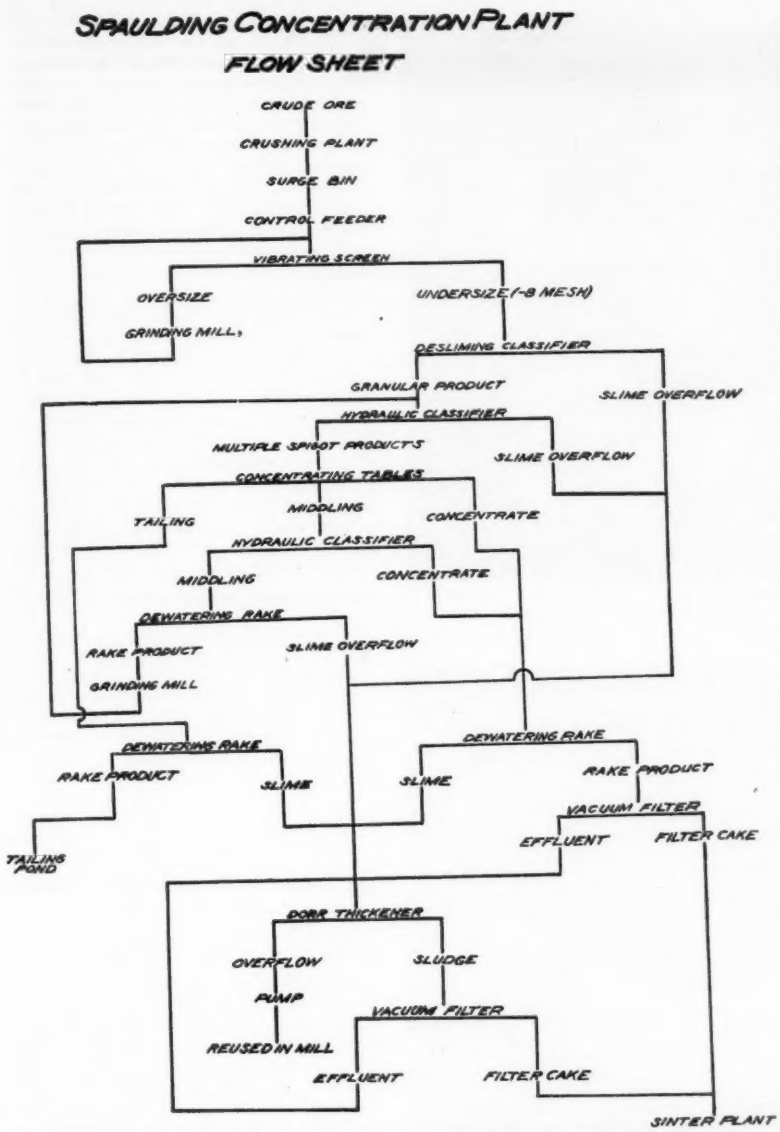
These are important advantages and constitute the reasons why magnetic separation is the beneficiation method exclusively used on the magnetite ores of the Adirondacks, and the magnetic taconites of Minnesota.

Unfortunately, hematite is only weakly magnetic. Taking metallic iron as 100, the magnetic attractability of natural magnetite is 40.18. The corresponding figure is 1.32 for hematite and 0.37 for quartz. Even this low attractability is enough to permit an operable process though it precludes the treatment of slime sizes. Hence, as in the processes previously discussed, a selective grind would be required, for application of the method to Big Seam ore or ferruginous sandstone, because any slime produced would have to be accepted as direct concentrate.

Magnetic concentration of hematite can be practiced in the dry way using cross-belt machines of the Wetherill type, but the capacity of all such as have been heretofore available is low. A new dry magnetic separator has recently been developed, for which higher capacity is claimed, but the outlook for Big Seam ore or ferruginous sandstone is unpromising.

This does not rule out magnetic separation, however, for there are two

*Adapted from a paper presented at the Birmingham meeting of the American Iron and Steel Institute, October 1949.



alternatives, one of which is direct magnetic recovery in high intensity machines operating in the wet way. The other is reduction roasting, which will be discussed later.

The Queneau Separator

The Queneau wet separator, under development within the U. S. Steel Corp., by Mr. A. L. Queneau, has been used to separate hematite from silica within a limited size range.

Several carloads of Big Seam acid ores from the Tennessee company have been put through a Queneau separator. After grinding to 14 mesh in a peripheral discharge rod mill, the pulp was deslimed at 100 mesh, with the sands being treated magnetically and the slimes accepted as finished concentrate. On the average, 64.6 percent of the feed iron was recovered in a magnetic concentrate assaying 45.8 percent Fe. The direct slimes accounted for an additional 23.1 percent of the iron, giving a total recovery of 87.7 percent of the iron units in these acid ores.

Reduction Roasting and Magnetic Separation

Hematite is one of the natural minerals that can be rendered strongly magnetic by proper heat treatment, in this case a reducing roast at 1000-1200 F. to convert it to magnetite. Artificial magnetite has the same high magnetic permeability as the natural mineral.

Curiously enough, that property of hematite was recorded in only one or two obscure literature references, when in 1892 it was independently discovered here in the Birmingham district through a fortuitous circumstance. A piece of Big Seam ore was seen to have undergone profound change after falling into the flue of a beehive coke oven of the Tennessee company. Recognizing the significance of this observation, the management assigned Dr. W. B. Phillips to investigate it. Dr. Phillips' scholarly studies extended over the years 1893-96 and were duly recorded. Patents were also taken out during that period.

Although successfully used on a large scale in recent years in Manchuria, under the peculiar economy existing there, the process of magnetic roasting of iron ore has never been commercially applied in the United States. This has been mainly because of the relatively high cost of the roasting step, and the consequent need of an advantageous location with respect to fuel and reducing agent.

Reduction roasting and magnetic separation is persistently more intriguing to investigators than any other process that might be adapted to the beneficiation of Red Mountain ores. The U. S. Bureau of Mines in 1927 carried on an extensive series of laboratory and semi-pilot plant tests. From the published report Table III has been prepared, showing results on high silica Big Seam ores as represented by the Ruffner mine of Sloss Sheffield and the Spaulding mine of Republic Steel.

TABLE II

REDUCTION ROASTING AND MAGNETIC CONCENTRATION OF SILICIOUS BIG SEAM ORE

	Ruffner	Spaulding
Feed Assay, %:		
Fe	40.3	33.0
Insol.	23.1	22.0
Lime	7.6	13.3
Concentrate, %:		
Fe	53.5	53.4
Insol.	14.8	10.6
Lime	1.9	4.7
Tail Assay, %:		
Fe	5.2	6.1
Insol.	45.0	37.0
Lime	22.8	24.7
% Recovery:		
Weight	72.67	56.87
Fe	96.5	92.0
Insol.	46.7	27.5
Lime	18.6	19.9

At the indicated iron recovery, the grade of concentrate at +53 percent Fe is higher than has ever been attained in the laboratory on unaltered hematite, even allowing for the slight difference due to pure magnetite theoretically assaying 72.4 percent Fe as against 70.0 percent for pure hematite. The improvement is undoubtedly due to better elimination of silica from slimes, which gravity concentration or flotation is intrinsically unable to cope with.

If the roasting cost could be brought into permissible range, reduction roasting and magnetic concentration would offer advantages in the problem

Surface plant of the Spaulding mine of Republic Steel Corp. High silica big seam ores from this mine were given extensive reduction roasting and magnetic separation tests

of beneficiating either Big Seam acid ores or ferruginous sandstone, for it does not require acceptance of unbeneficiated slime as concentrate, nor an elaborate and costly slime dewatering plant. It also avoids the necessity for selective grinding.

Two pilot plant operations have been carried out in the United States, using this process, one by Butler Brothers in 1935 on Mesabi ore at Cooley, Minn., and the other by the Sloss-Sheffield Co. in 1946 on highly silicious ore from the Ruffner mine on Red Mountain.

In the Butler Brothers test a shaft furnace fired with fuel oil was used for the roasting operation. Good metallurgy was obtained, but the cost was at that time unfavorable and the project was abandoned.

In the Sloss-Sheffield test, a rotary kiln was used, with natural gas as the fuel and finely divided high volatile coal mixed with the charge, as the reducing agent. After grinding of the reduced ore and magnetic separation, the concentrate was nodulized in a second rotary kiln. Operation of the pilot plant has been suspended, because of operating difficulties and high cost, but it is being held intact in the hope that further development will lead to an economic operation. It was found that reduction in a rotary kiln gave a product suitable for magnetic separation but it was extremely difficult to operate the fine grinding mill in closed circuit with a classifier because unlike experience on natural magnetite, the artificial magnetite, becoming polarized, could not be demagnetized sufficiently to permit classification. Inability to achieve expected capacity under the circumstances contributed to the high cost.

The Tennessee Coal, Iron & Railroad Co. embarked upon a program of ore beneficiation research in 1947. During the two years this has been in progress, the reduction roast, followed by magnetic concentration, has been found attractive on the grounds of superior metallurgical results provided the cost requirement can be met. In Table III are shown semi-pilot scale results in No. 14 Mine ore. They compare favorably with gravity concentration outcome on the same ore:

TABLE III

REDUCTION ROASTING AND MAGNETIC SEPARATION VS. GRAVITY CONCENTRATION OF NO. 14 MINE ORE

	Magnetic	Gravity
Grade of Ore, % Fe..	36.7	36.7
Concentrate, % Fe...	54.1	44.9
% Insol.	15.5	13.9
% CaO.	4.6	10.4
% Recovery, Fe.....	92.0	89.5
Wgt....	62.2	73.1

Headframe of the No. 14 ore mine may be seen against the distant backdrop of the buildings of downtown Birmingham

Modern fuel considerations being what they are, any investigator would be prone to shy away from any beneficiation process involving the use of heat, but it is precisely there that the Birmingham district finds itself in a position not duplicated in any other iron ore district in the United States. Despite the comparatively low iron tenor of the available ores, the steel industry in Birmingham has survived because of an adequate local supply of coking coal, and the fact that those ores were self-fluxing, or nearly so. Nevertheless, despite all improvements in blast furnace practice, the coke rate continues at 2200 to 2400 lb per net ton of iron produced, as compared with 1500 to 1800 lb for Northern furnaces. On the highly silicious No. 14 Mine ore now going direct to the blast furnaces, the calculated coke rate is actually 2622 lb.

It is at once obvious that, on heat balance, if the silicious ore now being shipped direct to the furnaces could be beneficiated into a product requiring less coke to smelt it, per ton of iron contained, the heat equivalent of the coke saved in the blast furnace could be used in the concentrating operation at no net increase in over-all fuel consumption. The question then is, can enough be saved at the fur-

naces to meet the requirement of reduction roasting That accomplishment is theoretically possible; practically, it is contingent upon the efficiency of heat utilization in the roasting process.

From Table III, blast furnace performance may be calculated and a comparison made between direct shipping of ore to the furnaces, gravity concentration, and magnetic concentration. This works out as shown in Table IV.

TABLE IV

DIRECT SHIPPING OF NO. 14 MINE ORE VS. BENEFICIATION

	Direct Shipping	Gravity Concentration	Magnetic Concentration
Grade to Furnace, % Fe	36.7	44.9	54.1
Tons Crude Ore to Make One Ton Iron	2.7	3.2	3.0
Furnace Requirement per Ton of Iron Produced:			
Coke, lb	2,622	1,988	1,773
Dolomite, lb	1,721	541	1,007
Slag Produced per Ton Iron	3,123	1,540	1,426
Tons Iron Produced per Day by Standard 800-Ton Furnace	732	966	1,083
% Increase in Production per Furnace Day	...	31	48

Compared with direct shipping, magnetic concentration reduces the furnace coke requirement by 849 lb per net ton of iron produced. On the metallurgy shown, 3.0 tons of ore is required to make a ton of iron. The amount of coke saved is therefore equivalent to 849/3.0 or 283 lb per ton of *ore*. At 12,500 Btu per lb, this is equivalent to 3,540,000 Btu. From the limited viewpoint of heat balance alone, the question reduces to this: "Can a ton of ore be roasted and reduced for an expenditure of 3,540,000 Btu?"

The bulk of the heat requirement is for bringing the ore up to reaction temperature. This varies relatively little with the grade of the ore and amounts to about 450,000 Btu per ton.

The reduction from hematite to magnetite is an endothermic reaction and the heat requirement is about 150 Btu per pound of hematite. On ores of the grade under consideration this would be a further 160,000 Btu per ton.

If the ore contains 3 percent moisture, the requirement to evaporate it and superheat the steam to reaction temperature would be another 120,000 Btu.

Thus the total requirement for drying, heating, and reducing, per net ton of ore, at perfect efficiency would be about 730,000 Btu, or 20.6 percent of the 3,540,000 Btu theoretically available out of coke savings.

If it were as simple as that, the reduction roasting of Red Mountain silicious ores would be attractive indeed, but on a practical basis a host of other factors require consideration. In Birmingham, natural gas or producer gas from coal are two of the fuels that could be used. Natural gas is not an effective reducing agent until the methane is converted to carbon monoxide and hydrogen, with loss of at least 25 percent of the Btu content in the conversion. A gas producer on coal would lose no less. Applying this factor, and also assuming the over-all efficiency of heat utilization in the roasting operation itself to be 50 percent, the theoretical requirement rises to about 2,000,000 Btu. In the Sloss pilot plant the average over-all heat consumption, exclusive of nodulizing the concentrate, approached this figure.

Fortunately, of course, there are other savings as shown in Table IV, such as increased production per furnace day, decrease in flux requirement, and in volume of slag to be handled. Out of all of these must come the total cost of operating the beneficiation plant plus a justifiable return on the substantial capital cost involved.

Altogether, then, there is at least a possibility, under the peculiar conditions existing in Birmingham, that silicious Big Seam ores could be beneficiated and prepared for blast furnace use at a net cost no greater than that of direct treatment of such ores now in production, with a chance of later reduction in cost as practice developed.

To do so will require that beneficiation process to be chosen which yields maximum grade of concentrate and maximum recovery of iron units, and at a cost competitive with other available processes in relation to the results obtained.

Magnetic Separation Process Most Favorable

As for the first requirement, reduction roasting and magnetic separation will yield better metallurgy than any other known process on Red Mountain ore, as far as can be seen today. It is true also that for magnetic ores, magnetic separation is one of the cheapest beneficiation processes ever developed. The concentrate coming off the separators in the Sloss pilot plant averaged 60 percent solids. At 60-75 percent solids, which should be attainable, direct filtering would be practical, thus eliminating the acres of thickeners that would be required in a large plant using any other wet process on these ores.

The cost outlook thus is favorable for every element of the process except the roasting, which, together with the drying of the ore as part of that operation, is an outright additive to the normal cost elements of other processes.

It is possible that some reduction in cost of roasting may be attainable by adapting the fluidized bed type of reactor to this problem.

Essentially, this device, which has been developed for the regeneration of spent catalyst in the oil industry, consists of a container with suitable means for introducing gas under pres-

(*Continued on page* 83)

At the business end of an iron ore loading unit

At the Ceredo plant on the Ohio River near Kenova, W. Va., the Truax-Traer Coal Co. prepares a quality product for rail and river shipment

Recovering and Desliming Fine Coal

How a Pilot Plant Utilizes Cyclones and Vacuum Filters to Make a Marketable Product

By R. L. SUTHERLAND
Combustion Engineer
Truax-Traer Coal Co.

FOR recovering fine coal from suspension in wash water, a cyclone was used on an experimental basis in cooperation with the Bureau of Mines in 1948. The work was done at the Shamrock Plant at Kayford, W. Va., where coal from the No. 2 Gas seam is washed. In this plant the washed coal is separated into a low-ash, by-product coal and a higher ash secondary product suitable for industrial fuel.

In the experimental work it was demonstrated that (1) a substantial tonnage of fine coal could be recovered from the water pumped to waste and (2) the plant could be operated in a partially closed circuit. A battery of four 14-in. cyclones was installed in 1948 to recover fine coal and an 18-in. cyclone to dewater partially the rejects from the Rheo plant. Final dewatering of the Rheo rejects is done on a small vibrating screen and the dried material is delivered to the main refuse belt.

The water leaving the launders with the rejects carried almost no material below 60 mesh and its recovery resulted in a considerable reduction in make-up water. After some experience in the operation of the cyclones, the water circuit was partially closed and is now operated almost completely closed. A relatively small amount of inert slimes is carried in with the raw coal and its retention in the circuit has little effect on the ash content of the coal recovered. The objectionable feature is an increase in moisture in the steam product with which the fines are mixed.

A comprehensive study of the water circuits in the four washing plants operated is now under way, having for objectives (1) the recovery of fine coal, (2) removal of inert slimes from the circuits, and (3) more effective dewatering of the shipped products. Cyclones have proved effective in recovering fine coal and, with other changes in the water circuits, are being used in removal of slimes.

Experimental work at the Illinois plants has shown that fine slimes, particularly particles in the sub-sieve range, tend to adhere to the surfaces of the coal particles, detracting from the appearance of the shipped product and increasing the ash content of the smaller sizes by measurable amounts.

The work outlined here has been carried on at the central cleaning plant at Ceredo, W. Va. Operation of the plant started June 1, 1949. Operation and experimental work have been retarded by the limited working time at the mines since that date. This paper is, therefore, only a progress report.

Investigation at Ceredo Plant

A preliminary exploratory sampling of the solids in suspension in various parts of the circuit has indicated the amount and character of the solids and provided useful information for the selection of pilot-plant equipment and the locations from which the solids should be drawn.

The plant is equipped with jigs for washing the coarser sizes and free discharge launders for the minus ⅝-

in. coal. The launder feed leaving the vibrating screens is sluiced into two 18-ft diam conical settling tanks from which it is elevated to the launders. Fine coal from the jigs, and that passing through the main classifying screens, is sluiced into a 32-ft diam tank. The washed by-product coal discharges into two 18-ft diam settling tanks and one 12-ft diam tank receives the steam product. All washed fine coal is elevated from the settling tanks to screen type centrifuges.

Overflows from all settling tanks flow to the recirculating tank. Overflow from the recirculating tank, together with the rejects from the launders and minus ⅝-in. rejects from the jigs, are collected in a refuse tank and pumped to the disposal area.

The preliminary investigation has indicated:

(1) The by-product coal is uniformly cleaned down to 200 mesh. (Table I.)

(2) The steam product is less effectively washed below about 30 mesh, with the ash increasing with reduction in particle size. (Table I.) The almost complete absence of solids below 60 mesh in the launder rejects accounts for the smaller sizes of high ash material appearing in the steam product.

(3) In the centrifuges, slimes below 200 mesh are reduced to 2-3 percent. (Table I.) The effluents from the centrifuges operating on by-product and steam coal are mixed in a single sluice. The combined effluent contains 12-13 percent of slimes below 200 mesh with ash ranging from 19-25 percent.

(4) The solids in the centrifuge effluent range in size from about 14 mesh down. The solids amount to 30-35 percent by weight.

(5) The heaviest loading of suspended solids of highest slime content is in the overflow from the launder feed tanks. The overflow from the settling tank receiving fines from the jigs and the main classifying screens is next in order, with the loading in

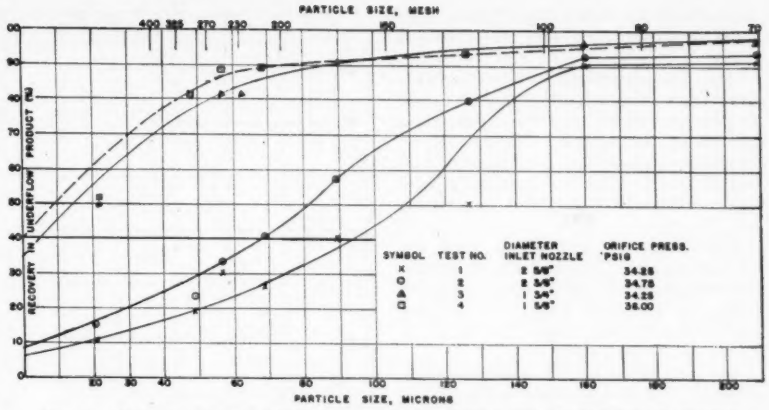

PARTICLE SIZE, MESH
400 325 270 230 200 150 100 80 70
RECOVERY IN UNDERFLOW PRODUCT, %
SYMBOL TEST NO. DIAMETER INLET NOZZLE ORIFICE PRESS. PSIG
X 1 2 5/8" 34.85
O 2 2 5/8" 34.75
Δ 3 1 3/4" 34.25
□ 4 1 5/8" 36.00
PARTICLE SIZE, MICRONS

Fig. 1. Relation between diameter of overflow nozzle and distribution of particle size in cyclone operation

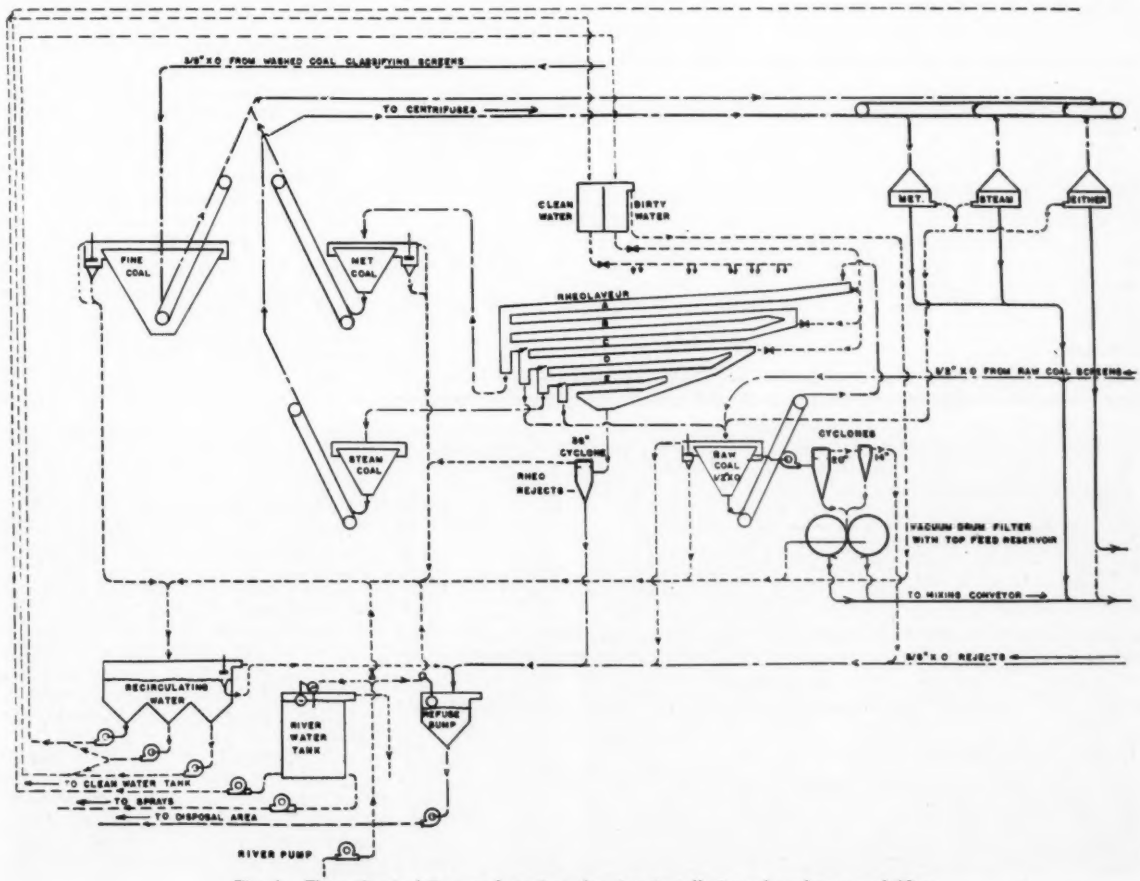


Fig. 2. Flow sheet of fine coal section showing installation of cyclones and filter

the overflows from the washed coal settling tanks containing the smallest amount.

(6) The suspended solids with overflow from the recirculating tank to the refuse collecting tank, amounting to 6-8 percent by weight, consist of 35-45 percent coal, most of which is low in ash, and 55-65 percent of slimes below 200 mesh with about 30 percent ash.

(7) When fresh water is used for vertical current water in the launders, the water carrying the reject material from the launders carries no slimes and contains only small amounts of solids below 60 mesh.

(8) Sampling of the solids in suspension at various levels in the launder feed tanks showed that at levels down to 5 ft below the surface, the ash content is low in all sizes above 100 mesh, with highest ash in the —200 mesh. (Table II.) The same condition was found in the settling tank receiving fines from the jigs and the main classifying screens. Size analyses of samples taken from various levels in the launder feed tanks are shown in Table II and corresponding ash contents in Table III.

The preliminary investigation indicated the possibility of recovering clean coal with a top size approximately that of the solids rejected by the screen type centrifuges directly from the raw feed, by-passing the fine coal launders and centrifuges, provided satisfactory mechanical dewatering could be effected.

Previous experimental and operating scale trials had demonstrated fine coal could be recovered from liquid suspension with cyclones. Also, that desliming could be effected at controlled separation size (Fig. 1). This appeared essential for practical mechanical dewatering. Complete recovery and cleaning of all fines would require the application of flotation methods. It was decided to determine the extent to which recovery and cleaning with gravity separation and mechanical dewatering could be applied.

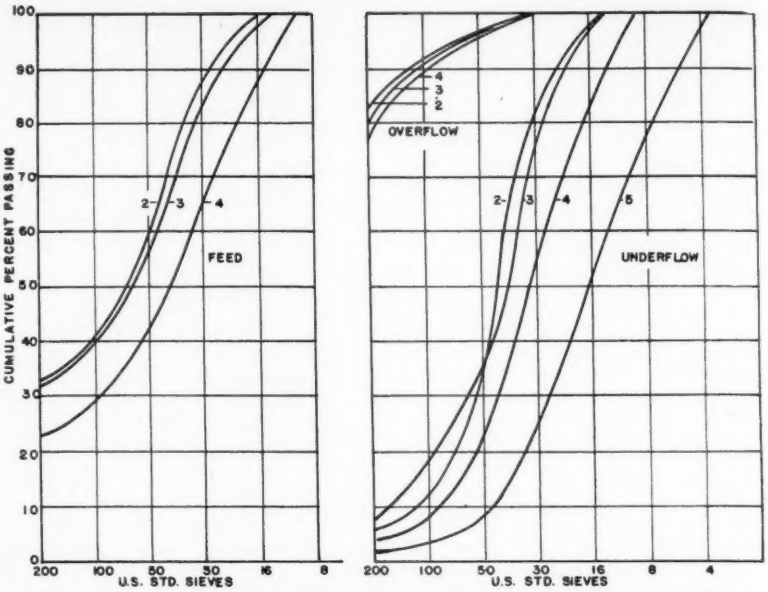


Fig. 3. Size consists of solids in cyclone feed, underflow and overflow for various depths below surface of launder feed cone

TABLE I
SIZE CONSIST AND ASH OF CENTRIFUGE PRODUCTS

Screen Size	By-Product Wt. %	By-Product Ash %	Steam Wt. %	Steam Ash %	Effluent Wt. %	Effluent Ash %
+½"	1.0	13.9	Trace			
½"×⅜"	4.6	6.9	2.7	30.1		
⅜"×¼"	12.8	6.6	7.6	21.0		
¼"×⅛"	23.6	5.5	20.5	14.1		
⅛"×14M	22.8	4.7	22.5	10.5	3.2	7.7
12× 30	20.0	4.4	29.9	10.1	34.1	8.6
30× 50	8.4	4.2	10.2	14.3	32.7	9.6
50×100	3.6	4.9	3.4	16.1	12.2	13.3
100×200	0.9	4.9	1.1	17.2	4.6	15.4
200× 0	2.3	7.7	2.1	18.9	13.2	18.8
Average		5.3		13.3		11.1

TABLE II
SIZE CONSIST OF SUSPENDED SOLIDS AT VARIOUS LEVELS IN LAUNDER FEED TANKS

Depth below surface, Ft Screen Size	Surface Wt. %	1 Wt. %	2 Wt. %	3 Wt. %	4 Wt. %
14× 30M	Trace	Trace	0.8	2.8	3.2
30× 50	1.8	3.7	8.1	24.7	27.8
50×100	17.5	18.5	30.6	27.5	27.3
100×200	16.5	14.4	12.2	9.8	9.7
200× 0	64.2	63.4	48.3	35.2	32.0

TABLE III
ASH IN SUSPENDED SOLIDS AT VARIOUS LEVELS IN LAUNDER FEED TANKS

Depth below surface, Ft Screen Size	Surface Ash %	1 Ash %	2 Ash %	3 Ash %	4 Ash %
14× 30M				3.5	3.4
30× 50		2.8	3.4	3.5	3.1
50×100	3.5	3.9	4.8	5.7	5.8
100×200	6.4	7.2	9.4	11.8	13.8
200× 0	29.6	28.7	30.7	32.2	32.2

Pilot Plant

With the background provided by the preliminary investigation, a pilot plant was installed to provide further and more complete information. The plant equipment consists of a 14-in. cyclone and a vacuum drum filter with a top feed reservoir, with the necessary pumps and piping.

The cyclone has a capacity up to 250 gpm of pulp and is capable of recovering up to 6 tph of bone dry solids. Underflow and overflow nozzles of various sizes permit changing the flow conditions and separation point.

The piping arrangement provides for drawing feed from three levels in a launder feed tank and from the bottom of the outer ring of the tank or from combinations of these sources. Provision has been made for adding wetting agents or coagulants to the feed.

The vacuum filter is a self-contained portable test unit built and loaned by the Peterson Filters and Engineering Co., of Salt Lake City. The company has made preliminary laboratory tests of the feed material and is cooperating in the pilot plant operation. The

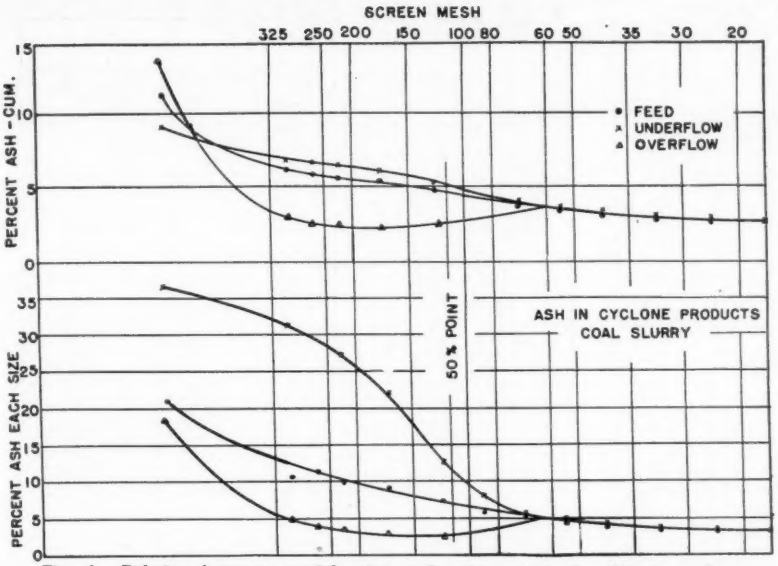


Fig. 4. Relation between particle size and ash content of solids in cyclone underflow

filter is equipped with variable speed drive on the drums, a vacuum pump capable of developing a vacuum of 10 in. of mercury at 30 cfm, filtrate tanks and pumps, gauges, etc. Syntron vibrators are installed in one drum.

Pilot Plant Operation

Since mining operations were resumed in March, the plant has been operated on an experimental basis. A considerable amount of data has been collected. It is not considered that the range of conditions covered to date is broad enough to warrant a statistically complete analysis. However, enough experience has been obtained to show (1) recovery of a satisfactory product of the desired size consists and ash content with almost complete removal of slimes has been obtained, and (2) moisture reduction in the filter has been as complete as was anticipated from the study of available data. Examination of the size consist data from which Fig. 5 was derived indicate the feed to the filter used in our tests was of smaller top size and, in most cases, contained less slimes.

Essential data for one series of tests of the cyclone are shown in Tables IV and V. Size consists of feed, underflow and overflow are shown in Fig. 3. The high percentage of oversize solids in the overflow is due to the high percentage of solids in the feed and underflow. Maximums of 10 percent solids in the feed and 50 percent in the underflow have been found practical operating limits for high recovery. Smaller amounts of solids in the feed result in more complete recovery in the underflow. In the commercial scale installation provision has been made for removal of the greater part of the coarser solids in a cyclone of large capacity with the overflow passing to three smaller cyclones in parallel.

The cyclone acts as a cleaner only when the high gravity particles are in sizes that pass out in the overflow. For particles of any given size, those of higher gravity tend to report in the underflow. This is shown in Fig. 4,

TABLE V

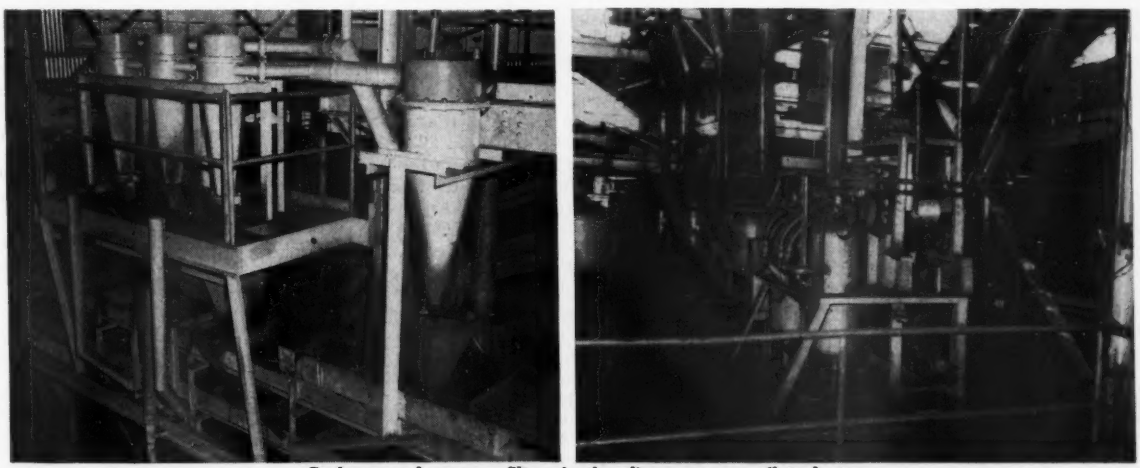
SIZE CONSIST AND ASH IN CYCLONE UNDERFLOW-FEED FROM 4 FT BELOW THE SURFACE OF LAUNDER FEED TANK

Screen Size	% Wt.	% Ash	% Ash (Cum.)
+14M	13.3	4.5	4.5
14× 30	28.5	3.9	4.1
30× 50	30.2	4.6	4.3
50×100	16.4	7.5	4.9
100×200	5.6	13.8	6.0
200× 0	6.0	34.3	7.2

TABLE IV

RESULTS OF CYCLONE OPERATION ON FEEDS FROM VARIOUS LEVELS IN A LAUNDER FEED TANK

Depth below surface, Ft	2			3			4		
	Feed	Underflow	Overflow	Feed	Underflow	Overflow	Feed	Underflow	Overflow
Pulp, gpm	191	31.5	159.5	196	29.4	166.6	195	40.1	154.9
Solids, Wt. %	15.3	55.2	6.6	15.2	57.1	6.2	19.6	60.4	6.7
Solids, tph	7.67	4.95	2.72	7.81	5.47	2.64	10.21	7.55	2.66
Recovery, % of Feed	100	64.5	35.5	100	66.2	33.8	100	73.9	26.1
Recovery, % of plus 200M		90.4			89.9			92.0	
Ash, %	10.9	6.8	18.4	11.5	7.5	19.9	9.4	6.6	17.5



Cyclones and vacuum filters in the slime recovery pilot plant

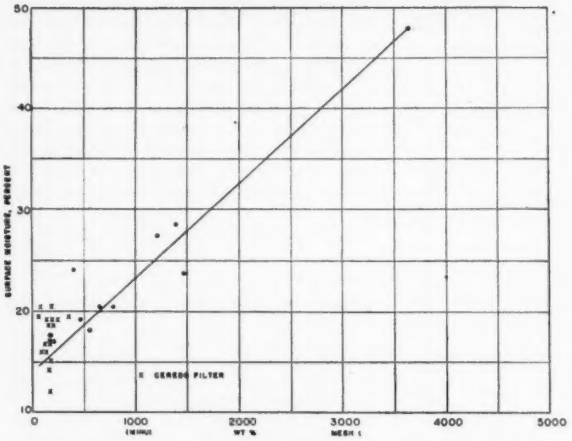


Fig. 5. Relation between the surface moisture content of a filter cake and the size-consist and ash content of the fine coal in the filter feed

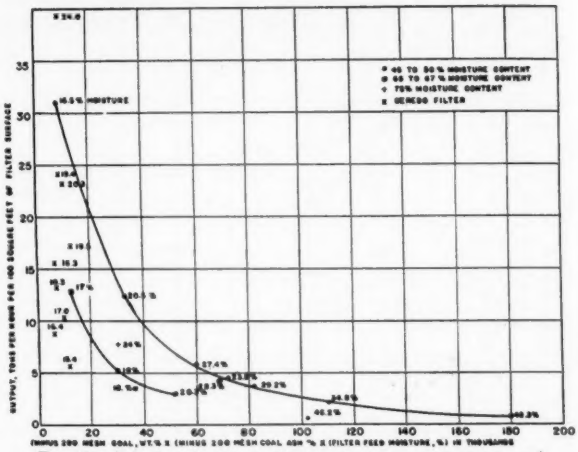


Fig. 6. Relation between filter output per unit area and the size-consist ash content, and moisture content of the filter feed

prepared from earlier experimental data.

Data on the operation of the cyclone were available from earlier test work at Shamrock No. 1 mine and from operation at Ceredo before the filter was ready for operation. These data provided background information from which the results of the filter operation could be estimated.

An estimate of the moisture to be expected in the filter cake has been made from information available in the literature. Lyons, using data from several sources, has developed a chart showing a fairly definite relation between (1) the product of the weight per cent of -200 mesh material and its ash content and (2) the moisture content in the cake from vacuum filters. He also developed a chart showing the effect of the same factors, together with the moisture content of the feed, on filter capacity. The charts are reproduced as Figs. 5 and 6 with the results from the Ceredo tests added.

Because of the limited data on which the higher filter capacities shown in Fig. 6 are based, no attempt has been made to predict filter capacity. However, the location of the broken lines showing data from the present tests indicates capacities in the higher ranges can be expected.

Filter Operation

Experimental operation of the vacuum filter to date has demonstrated that the underflow from the cyclone, containing up to 50 per cent solids, is a suitable feed for the filter and that a considerable range of solids in the feed, both as to size consist and solid content, can be dewatered to a satisfactory degree.

Capacities per square foot of effective filter area have been measured over a narrow range of size consists and slime contents. The points on Fig. 6, representing data from the tests, indicate that, for the conditions observed, moisture reduction and capacity are closely related. Other factors appear to affect result to some degree. A tentative correlation between the product of drying time and air flow rate per unit of weight of product and the moisture in the product indicates that moisture reduction is in part a function of the volume of air passing through the filter bed.

Information on the effect of vibration of the filter surfaces is inconclusive as of this date. The small size and rigidity of the test unit are not favorable to developing the maximum effect of the vibration. It has been noted the cake on the drum equipped with the Syntrons is more compact than on the other drum not equipped with vibrators.

The dried product of the filter is a granular material that does not form a cohesive cake. There has been no tendency to form balls or lumps. This appears to be due to the almost complete removal of slimes from the feed and avoidance of degradation in the dewatering process.

Since the investigation at the Ceredo plant was initiated, three changes in plant operation have been made, viz.: (1) skimmers have been installed in the outer rings of the two launder feed tanks to permit a portion of the total overflow containing less coal to pass directly to the refuse tank. The amount of clean coal lost in this overflow is less and the amount of fine slimes greater than in the overflow from the recirculating tank. (2) A 36-in. cyclone has been installed to dewater partially the launder rejects, the overflow water being returned to the recirculating tank to replace water by-passed to the refuse tank from the launder feed tanks. The cyclone is operated on gravity feed with a maximum head of about eight feet. (3) Centrifuge effluent is returned to the launder feed tanks for retreatment.

A battery of two 20-in. and six 14-in. cyclones has been installed. These will act initially as deslimers and to determine the extent to which clean fine coal can be recovered from the launder feed and washed coal settling tanks. Underflow solids will be dewatered in the centrifuges until separate final dewatering equipment can be installed.

Summary

(1) Fine coal has been recovered and deslimed in a cyclone.

(2) The deslimed coal is an acceptable feed for vacuum filtering for the production of filter cake of relatively low moisture at high capacity.

(3) By combining hydraulic classification effected in the launder feed tanks with recovery and desliming in a cyclone, a clean product has been recovered directly from the raw coal cones.

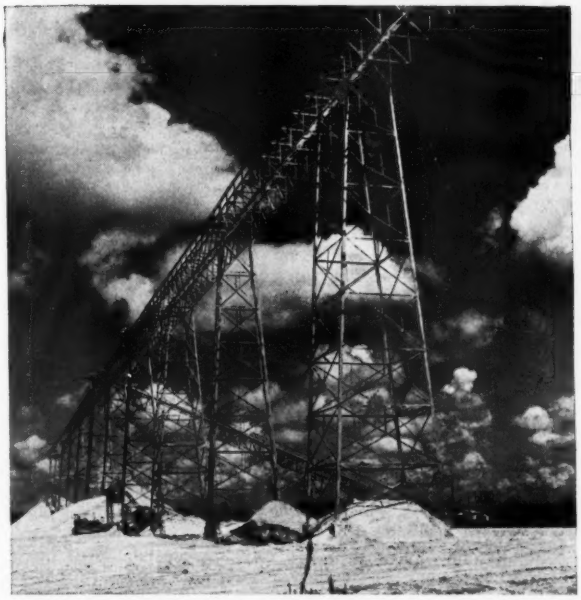
(4) Fine coal having a top size equivalent to that of the solids in the effluent from screen type centrifuges has been recovered. The proportion of the total fine material that can be recovered ahead of the launders and centrifuges has not been determined. This will require full scale operation.

(5) The cyclone cleans only by removal of high ash slimes.

(6) Moisture removal in the experimental filter has been as complete as was expected from the examination of available information.

(7) Some reduction in the finer sizes of high ash slimes has been effected in the filter.

FROM START...TO FINISH



Wet rock storage area showing incline belt to trestle and trestle shuttle belt. A bulldozer pushes rock down hopper onto tunnel belt.

Incline belt to dryer receiving wet rock from tunnel reclaiming belt. View also shows dry rock storage belt gallery.

U. S. CONVEYOR BELTS INSURE CONTINUOUS FLOW OF PHOSPHATE ROCK

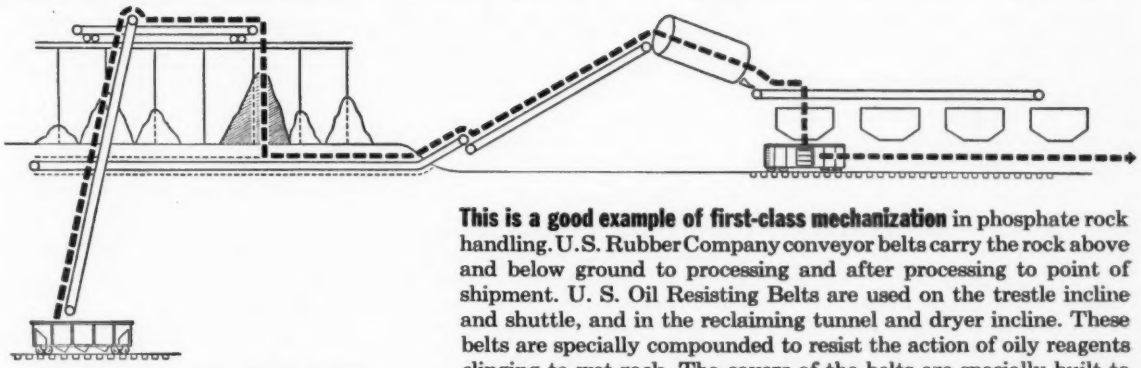


Diagram of continuous flow in phosphate rock handling field. U. S. Belting literally does all the haulage—from start to finish.

This is a good example of first-class mechanization in phosphate rock handling. U.S. Rubber Company conveyor belts carry the rock above and below ground to processing and after processing to point of shipment. U. S. Oil Resisting Belts are used on the trestle incline and shuttle, and in the reclaiming tunnel and dryer incline. These belts are specially compounded to resist the action of oily reagents clinging to wet rock. The covers of the belts are specially built to withstand the deteriorating effect of the hot sun's rays.

The dry rock storage belt is a special U. S. Hot Lump Belt of great ruggedness, especially resistant to the destructive effect of the heat from the hot, dry rock.

"U.S." belt experts are constantly finding new ways to make belting save you more money, step up your output. When you plan a new conveyor system, or when you wish to replace your present belt, get in touch with United States Rubber Company engineers.

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Percentage Depletion—Nullification by Interpretation

Far-Fetched Construction Placed on Law Would Contravene Congressional Intent

By RAYMOND B. LADOO
Consulting Engineer
Newton, Mass.

THE ultimate decision rendered in a recent case heard in a Federal Tax Court in Washington, D. C., may have an important and perhaps vital bearing on the financial position of many companies in the mining field. In fact it may impair the ability of some small operators to continue in business.

This case was concerned with the interpretation of the Act of Congress which allows percentage depletion of 5 percent on coal, 15 percent on metallic and certain specified nonmetallic minerals, 23 percent on sulphur and 27½ percent on petroleum and natural gas. Depletion is allowed on the gross income from the property. Gross income, as defined by the statute, is as follows:

"(B) DEFINITION OF GROSS INCOME FROM PROPERTY. As used in this paragraph, the term 'gross income from the property' means the gross income from mining. The term 'mining,' as used herein, shall be considered to include not merely the extraction of the ores or minerals from the ground but also the ordinary treatment processes normally applied by mine owners or operators in order to obtain the commercially marketable mineral product or products. The term 'ordinary treatment processes,' as used herein, shall include the following: (1) In the case of coal—cleaning, breaking, sizing, and loading for shipment; (2) in the case of sulphur—pumping to vats, cooling, breaking, and loading for shipment; (3) in the case of iron ore, bauxite, ball and sagger clay, rock asphalt, and minerals which are customarily sold in the form of a crude mineral product—sorting, concentrating, and sintering to bring to shipping grade and form, and loading for shipment; and (4) in the case of lead, zinc, copper, gold, silver, or fluorspar ores, potash, and ores which are not customarily sold in the form of the crude mineral product—crushing, grinding, and beneficiation by concentration (gravity, flotation, amalgamation, electrostatic, or magnetic), cyanidation, leaching, crystallization, precipitation (but not including as an ordinary treatment process electrolytic deposition, roasting, thermal or electric smelting, or refining), or by substantially equivalent processes or combination of processes used in the separation or extraction of the product or products from the ore, including the furnacing of quicksilver ores. The principles of this subparagraph shall also be applicable in determining gross income attributable to mining for the purposes of sections 731 and 735."

In most cases mineral producers do not receive an allowance of the full 15 percent since the statute limits the deduction to a maximum of 50 percent of the net income from the property.

The Commissioner of Internal Revenue of the Treasury Department has attempted to nullify certain sections of this paragraph in a notice of tax deficiency for the calendar years 1944 and 1945, sent to the International Talc Co., which mines and processes talc near Gouverneur, St. Lawrence County, N. Y.

Stripped of legal verbiage, the Commission's contentions are:

(1) That the product mined and sold is not 100 percent mineralogically pure talc, but contains important percentages of tremolite, quartz, serpentine, diopside and other minerals.

(2) Since the statute does not specifically provide for depletion on these other minerals, depletion must be disallowed for all but the mineralogically pure talc content, which they arbitrarily set at 40 percent. (At one stroke this disallowed 60 percent of the depletion allowance which had already been accepted.)

(3) That simple grinding to 97 percent or more through a 325 mesh screen constitutes steps beyond ordinary treatment processes and *"does beneficiate the product in greater degree—than crushing and concentrating by gravity and flotation."*

(4) Since ground talc is the first marketable form and "there is no representative market or field price, it is necessary to compute the 'gross income from the property'" under the provisions of the statute, by arbitrarily assigning a portion of gross profits to the mining of the crude talc. (This, further, very materially reduced the depletion allowance.)

International Talc Co. protested these disallowances and petitioned for a hearing in the Federal Tax Court. This case was heard in Washington before Judge E. H. Van Fossan on March 1-2, 1950. A decision will not be made for several months.

At the trial the principal questions presented were what is meant by the word "talc" in the statute and whether grinding to 325 mesh constitutes ordinary treatment processes normally applied to produce the commercial product.

The Bureau of Internal Revenue contended that "talc" means mineralogically pure talc and nothing else—that if Congress had meant "commercial talc" or "industrial talc" it would have said so in the statute. The International Talc Co. stated that its product has been known as talc for over 50 years, by geologists, engineers, producers, consumers, the U. S. Bureau of Mines and many other agencies. It is ordered as talc by customers, billed as talc and shipped as talc. They were able to show that, at the Congressional hearings in June 1947, when the reinstatement of the depletion allowances of the Revenue Act of 1943 (terminated Dec. 31, 1946) was under consideration, witnesses definitely stated that they were concerned with "commercial talc." Mineralogically pure talc was not mentioned.

Of course it is clearly evident that, at this hearing, producers of talc, fluorspar, barite, vermiculite and other minerals were talking about the commercial products which they mined and sold, not theoretically pure minerals which they did not produce. Thus "gravel" grade fluorspar, by definition, may contain as little as 65 percent pure calcium fluoride. Yet the whole product is shipped and sold as fluorspar. Many other examples can be readily cited.

As a matter of fact, no one knows the "mineralogically pure" talc content of the talc products which Inter-

national Talc Co. ships from day to day—and no one cares. Furthermore it is practically (if not actually) impossible to determine the theoretical talc content of any shipment. This St. Lawrence County, N. Y., talc is an alteration product, in various stages of alteration, from the original dolomite. Alteration has resulted in extremely intricate intergrowths of hydrous magnesium silicate (talc and serpentine), calcium-magnesium silicates (tremolite and diopside), iron-magnesium silicate (antrophyllite), quartz, residual dolomite, and other minerals, in constantly varying proportions, and usually in pseudomorphs after other minerals.

Neither by chemical analysis nor microscopic examination can the theoretical mineral composition of any shipment be determined quantitatively. The quality of ores mined and shipped to the mill to fill orders for any specific standard grade is determined very largely by inspection, based on long experience. Quality control of products shipped is by laboratory testing of the physical properties of fineness, oil absorption and color. Theoretical mineral composition is not determined or determinable nor is it of the least importance at any stage of the operations.

At the trial the Government made little efforts to contradict these facts. They did, however, attempt to show that grinding to 97 percent or more through 325 mesh was extremely fine grinding, a much more extensive and expensive job than the crushing, grinding, and concentration of metallic ores. They claimed that this was "beneficiation."

The Bureau of Internal Revenue agreed that International Talc Co. made no sales of crude talc and that there was no representative market price for crude talc.

The International Talc Co. contended that grinding to this fineness is not only not unusual but, in fact, is almost standard practice in the nonmetallic mineral fillers industries. The opening in a 325 mesh screen is 44 microns and grinding to ten or five or even two microns is becoming commonplace in the industry. Grinding to 325 mesh is also common practice in the preparation of some ores for flotation. Furthermore, it was pointed out that simple grinding is not "beneficiation" at all, since no impurities are separated from the crude ore. The ore is not "refined" as the Government contended.

The taxpayers showed that the methods and equipment used in grinding its talc are the usual and ordinary methods common to the whole talc industry and practically standard among producers of nonmetallic mineral fillers.

A Government witness attempted to describe in detail their "policies" used in applying the mineral depletion statutes and to "treat all of these taxpayers fairly." But it was pointed out by the taxpayers' counsel that the law was supposed to govern, not advance the theories of individuals in the Bureau of Internal Revenue. The Government then abandoned this line of argument, but not before it was drawn from this witness that his own district field engineer, of 30 years' experience in the Bureau's mineral evaluation section, disagreed with the Government's views in this case and agreed with the talc company's contentions.

One of the two major points in this case involves mineral nomenclature. It is unfortunate that we have to use the same word "talc" for both the pure mineral name and for the commercial product. We have more or less exact mineral definitions, but we have no commercial definitions for mineral products as shipped and used. Our inexact nomenclature causes endless trouble in interpreting the language of patents, laws, tariffs, railroad freight rates, contracts and other documents. But the courts have repeatedly held, in tax cases, that the ordinary, every-day, commercial interpretation of semi-technical language shall be followed, not the narrow, strictly technical definitions. If precedent is followed in this case it seems clear that the Government's contention as to "pure talc content" cannot be upheld.

It is rumored that the Bureau of Internal Revenue might follow up this case with similar depletion allowances in other mineral production cases. If this far-fetched interpretation of the law is upheld it is fairly clear that other mineral producers may suffer serious disallowances in their percentage depletion from 1944 to date.

Bureau of Internal Revenue, Washington, D. C.

An overburden blast of 6000 lb of dynamite heaves high, but results in excellent breakage

Vibrations From Heavy Overburden Blasting

Popular Concepts Exaggerate Seismic Effects

By L. DON LEET
Seismologist in Charge
Harvard University Seismograph Station

VIBRATIONS in the ground are an inevitable by-product of the use of dynamite to break rock or earth. In recent years, a great deal of information has been accumulated about the nature of these vibrations, their effects on structures, and systems of shooting which reduce the vibrations from given total amounts of explosive while increasing the efficiency of rock and earth shattering. Some of this information which bears directly on problems presented by vibrations from heavy overburden blasting is summarized here.

Earth Waves

Our earliest knowledge of waves in the ground came through instrumental registration of waves from earthquakes. Beginning in the early 1920's, methods came into use for prospecting for minerals, particularly petroleum, using portable seismographs. These seismic prospecting techniques led to the development of what is today practically an industry in itself, using earth waves for this purpose. Such techniques, however, are concerned primarily with measuring the speed with which certain waves travel in different materials, and contribute little in the way of either instrumentation or basic knowledge to our present problem.

In 1930 the writer started using a special seismograph for the accurate measurement and analysis of earth waves generated by the firing of explosives in the ground. This equipment was superseded after the war by the present Leet three-component portable seismograph which changed none of the basic principles but reduced a cumbersome combination of separate units to a single black box which is called portable because it has three handles. It weighs 65 lb.

From 1935 to 1940, the U. S. Bureau of Mines conducted an extensive research program "to ascertain the physical characteristics of seismic disturbances from blasting in quarries and to evaluate their effect on typical structures." The results of these investigations were summarized in the now-famous Bulletin 442, first printed in 1942.

During the past 20 years, the writer's personal observations have included vibrations ranging from those caused by a pound at a few feet, through the largest quarry shot in history to date (1,362,985 lb) at 8000 ft, to the first atomic bomb (in New Mexico, July 16, 1945) at five miles. Between these extremes there were a wide range of commercial blasts, including those used in strip mining, and a variety of industrial machinery and traffic sources.

The waves that cause the greatest ground movement around heavy overburden blasting are what are known technically as surface waves. If a picture could be taken showing the wrinkling of the ground which they produce, these would look much like waves on water. The great difference is that they are only a few thousandths of an inch in height, which makes it impossible to get a picture of the surface that would show them. The distance between crests, called the wave lengths, is from 100-300 ft. This means that buildings or other structures which are only a fraction of a

wave length in greatest dimension move as a unit on the passing wave, much as a floating crate would on a long, gentle ocean swell. This mechanism greatly reduces any hazard of damage because they are negligible differential stresses set up in the structure—everything moves the same way at the same time. For the same reason, buried pipes, tunnels, cellars, and concrete units such as basement floors and sidewalks resting directly on the ground simply cannot be damaged by any earth waves from commercial blasting that have ever been observed. This, of course, refers to waves a wave length or more away from the zone of shattering; in other words, where the ground movement is purely elastic.

This feature of wave motion in vibrations from blasting is not in accord with many fantastic proposals that have been made by people who picture the vibrations as crashing into the side of a building nearest the blasting, like a missile, or running up frame members and across girders like an electric current, pushing a foundation block out of line here or cracking the middle of a plaster panel there.

Damage from Blasting

The program of the U. S. Bureau of Mines, conducted specifically in the public interest and certainly in a completely objective manner, did not find a single case in which damage resulted from commercial blasting. As a result, they found it necessary to devise special tests in which blasting was carried to a point where damage was finally caused in a frame dwelling available to them. They drove an adit heading directly under the house, 70 ft below it, and fired charges increasing in size until plaster cracked. On one occasion, motion was 90 thousandths of an inch (.090 in.), and on another between 200 and 300 thousandths of an inch (.200-.300 in.) when cracks appeared. They later attached an eccentrically rotating machine to a test house to work out the damage limits under controlled conditions.

The writer, likewise, in over 20 years of looking, has not yet observed a single case of damage from vibrations caused by commercial blasting.

It seems that an investigator is always just too late. He is told of the shot he has just recorded, "That was nothing—you should have been here yesterday (or last month)." After listening patiently to countless tales of plaster cracking from blast vibration, yet never observing any place where they were present, scientists of the Bureau of Mines on one occasion made an exceptionally detailed map of a man's plaster ceiling. A month later, they received a wire that new cracks had been opened by another blast. They returned, compared the ceiling with their map, and found not only that the "new" crack had been

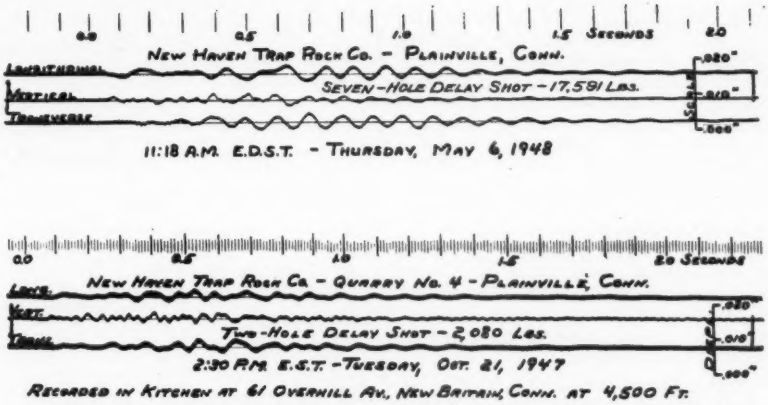

Fig. 1. Maximum displacements of these shots at the same place was equal as was the character of the motion

there all the time but actually that one of the previously mapped cracks had closed up to such an extent that it could not have been found without the map. With at least 40 known natural causes for cracking in plaster, the phenomenon is universal and normal. Further, nobody has ever known at a given instant exactly how many cracks there were in his house, and anyone making a special search can find some he hadn't seen before.

Short Delay Blasting

All of those observations up to 1945 involved vibrations resulting when the explosive in a given shot was detonated instantaneously. Immediately after the war, a technique was developed by explosives companies for delaying the detonation of adjacent holes or groups of holes by intervals measured in thousandths of a second. This led to the modern practice of so-called split-second delay, millisecond delay, or short delay firing.

In recent years, experience with this type of firing has shown that it is capable of reducing the already small amount of vibration from various total amounts of explosive. Some of our best evidence along these lines comes from rock quarries where vibration studies have been conducted for many years, but the principles apply to overburden blasting in strip mining equally well.

The exact mechanism by which delay shooting reduces vibrations has not yet been established. It appears logical that it may involve a combination of what has been called *decoupling*, or partial shattering around one hole so the gases from the next work into some broken as well as some solid rock, and *interference*, or partial cancellation of the surge of fracture from one hole as its neighbor lets go at the right instant. An extensive program of research will be necessary to prove even that these effects are operative. On the other hand, it is no mere academic matter, for a complete understanding of the process will pave the way for precise engineering of the spacing, burden, and delay interval in each type of material for best results. At the present time, our best measure of success is the size and type of vibration pattern which, as a by-product produced by wasted energy, forms the basis for an estimate of the efficiency of the shot.

One significant relationship that has been determined empirically is that the best effects in vibration reduction from delay firing do not appear to be

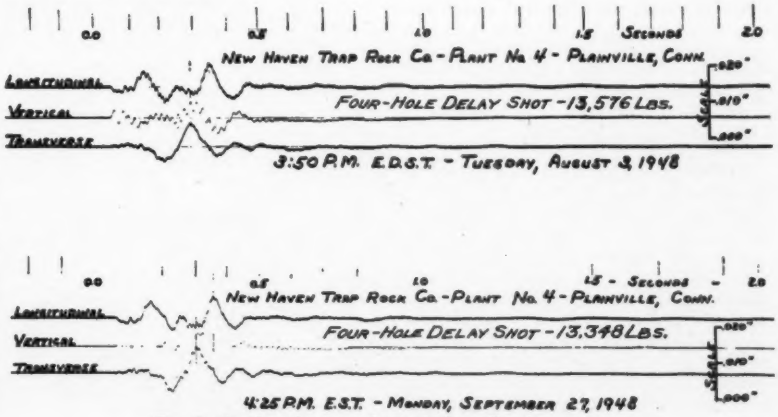

Fig. 2. Similar shots produce similar vibration patterns

realized until some minimum number of holes is exceeded. The present trend of the evidence is that the minimum is around seven holes. A series of observations illustrating this has been made available through the courtesy of the New Haven Trap Rock Co. and their safety engineer, T. W. Jones. All records were taken by Ranald Jones, field engineer, for the Vibration Engineering Co.

Fig. 1 compares vibrations at the same recording location from a two-hole shot of 2080 lb and a seven-hole shot of 17,591 lb. The patterns were similar and the maximum displacements were equal.

Fig. 2 shows two records at a point closer to the quarry from different four-hole delay shots. This illustrates the extent to which similar shots produce similar vibration patterns.

Fig. 3 shows two other records taken at the same recording location as those of Fig. 2. In this case, the top record is from a 12-hole delay shot of 37,772 lb and the bottom record from a three-hole delay shot of 12,000 lb. The maximum displacement from the 12-hole shot was appreciably less than that from the three-hole.

The data applying to five shots recorded at the locations in Figs. 2 and 3 are tabulated below.

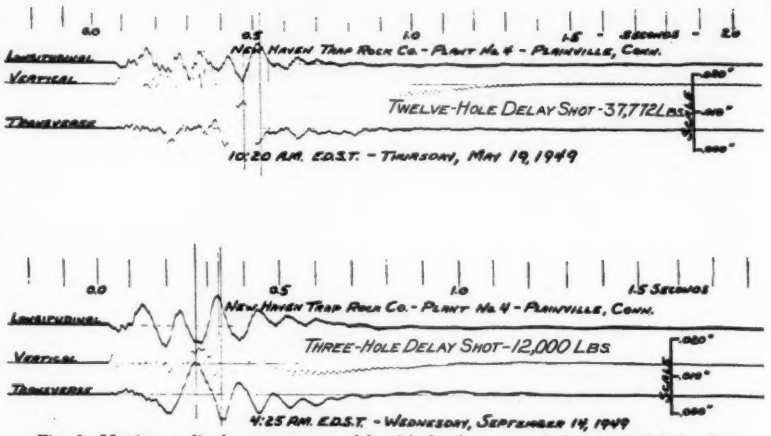

Fig. 3. Maximum displacement caused by 3-hole shot exceeded that of 12-hole shot

NEW HAVEN TRAP ROCK CO.'S RECORDS AT 2500 FT WEST OF PLANT NO. 4, PLAINVILLE, CONN.

Date	Total Charge (lb)	No. Holes	Max. per Hole (lb)	Spacing (ft)	Max. Displacement (in.)	
1948 May 19	17,591	7	2,549	27×25×126	.005	
1948 Aug. 3	13,576	4	3,452	28×28×138	.007½	Fig. 2
1948 Sept. 27	13,348	4	3,779	28×28×137	.007½	Fig. 2
1949 May 19	37,772	12	3,521	28×28×125	.008	Fig. 3
1949 Sept. 14	12,000	3	4,100	26×28×137	.011	Fig. 3

Seven-hole shot fired west to east; others fired east to west.

There is some evidence in the table that the maximum load per hole is important, as might be expected. At the same time, the difference between the three-hole shot and the second four-hole shot is out of proportion to the 321 lb difference in maximum per hole, particularly when it is noted that the two four-hole shots gave the same maximum vibration although the maximum per hole for one was 327 lb greater than that for the other.

Legal Problems

It is difficult to use explosives nowadays without encountering objections from some one living in the neighborhood. The objections range from inquiries of sincere people mistakenly concerned lest their property be damaged to the ranting of lying psychopaths. Science has developed the means for measuring the effects and setting safe limits for vibrations, by which it is possible to accurately evaluate the validity of complaints or claims. Unfortunately, legal processes by which these things are sometimes adjudicated are a couple of centuries behind the times. A jury of any kind is allowed by court procedure to find as "fact" things which are scientifically known to be impossible, which involve technical features that very few laymen could be expected to comprehend. Certain laws governing waves in the ground are understood as well as the law of gravity. When an expert explains that it is a physical impossibility to shatter a house 2½ miles away by vibrations from a quarry shot of 500 lb, his statements are derisively characterized as mere opinion and academic abstractions in no way entitled to comparable consideration with the wishful guesses of the house's occupants. In one sense, of course, such statements are opinion. In the same sense, if asked whether a pencil held in his hand would fall toward the floor or the ceiling if released, a scientist would say it will fall toward the floor. This is mere opinion until the pencil is released and the actual fall is observed. In the case of the 2½-mile house, a jury in its legally infinite wisdom awarded the plaintiff $10,000.

Once the "facts" are found by a jury, higher courts can usually concern themselves only with whether ground rules were violated during the trial. Under these circumstances, it is surprising how many technically sound verdicts have been returned. In fact, it's slightly amazing that any have been returned. On the other hand, some of the exceptions are extremely discouraging to anyone interested in truth and proven fact.

Political considerations all too frequently enter the picture when local authorities become more concerned

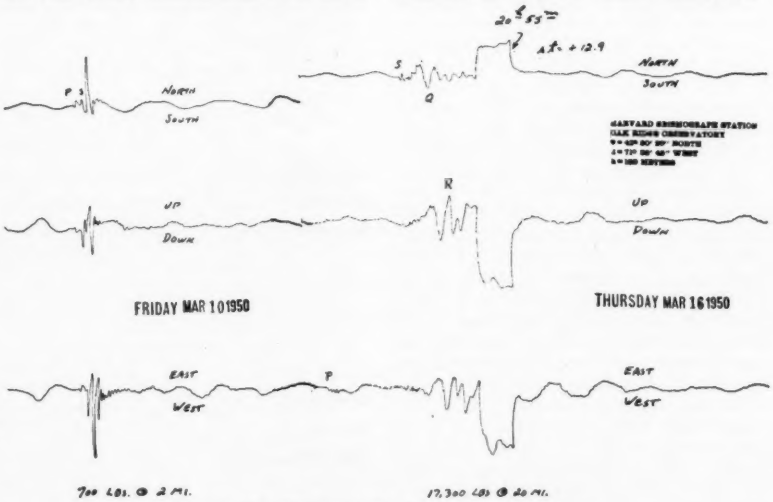

Fig. 4. The "fingerprint" of every shot is unique

with a few votes than the protection of legitimate enterprise. There is an unhealthy unbalance right now in all parts of the country, when any crackpot with a synthetic grievance can put a user of explosives to great expense and trouble to defend himself while the complainant has no responsibility regardless of how libelous or slanderous it can be proven he has been. Certain types of newspaper, too, have shown themselves completely irresponsible in reporting wild and unsubstantiated stories connected with the effects of blasting operations.

The worst possible procedure is to have local authorities undertake to control blasting by setting limits to the number of pounds that can be fired at any time. Fig. 3 and countless other experiments have shown that so far as vibrations are concerned, it is often possible to get more when the only change is the reduction of the amount of explosive.

It is completely unreasonable to attempt to judge the effects of vibrations by listening to the comments of people in the vicinity.

The only sound method of controlling blasting from the standpoint of the effect of vibrations is to set a limit on the magnitude of the vibrations produced. Then you're dealing with something tangible. Pennsylvania is the first state in the Union to approach the problem from that angle. Its Act No. 472, approved June 27, 1947, reads as follows in Section 20: "The use of explosives for the purpose of blasting in connection with strip mining in the neighborhood of any public highway, stream of water, dwelling house, public building, school, church, commercial or institutional building or pipe line shall be done in accordance with regulations prescribed by and under the supervision of the Department of Mines." Among the rules adopted by the Department of Mines, under the direction of Hon. Richard Maize, Secretary of Mines, was: "In no case shall the ground displacement be in excess of 0.03 in. at any dwelling house, public buildings, schools, churches, commercial or institutional buildings." This represents the most constructive step taken in the history of the problem of what part should be taken in this field by public officials.

The limit set in Pennsylvania is conservative from the standpoint of property owners. To reduce it to more homely terms than experiments of the U. S. Bureau of Mines or others, motion of up to 0.03 in. is caused by a man jumping two or three inches off the floor of an ordinary frame dwelling. At the same time, the amount of explosive necessary to produce 0.03 in. displacement in any buildings adjacent to most stripping operations is such that this limitation does not impose hardship on operators.

In an area like the anthracite district around Hazleton, Pa., a great problem in keeping full records of the vibrations from strip mining has been presented by the large number of operators and shots per day. The Vibration Engineering Co., of which the writer is an officer, has found that its Hazleton office cannot at any reasonable cost supply enough field engineers and Leet seismographs to record every shot at each pit. A new instrument recently developed at Harvard by Dr. Roland K. Blumberg, however, offers a solution. It records continuously with ink on plain paper 24 hours of the day. In contrast, the present equipment runs for only a few seconds at a time and records on photographic paper. Centrally located, the new equipment could record vibrations from every shot in the area, whether shooting schedules were known in advance or not. After the calibration of each individual pit by records on both the Leet portable and the new fixed instrument, the central station could stand watch on every shot and record any changes in vibration level due to changing amounts of explosive or methods of detonation.

Fig. 4 shows two records obtained by this system, one of 700 lb at two miles and the other 17,300 lb at 20 miles. Each shot location has a signature as unique as a man's fingerprints. From the time between the arrival of the primary waves, marked "P," and the secondary, marked "S," distance can be computed. Characteristics of other waves, such as those marked "Q" and "R," also aid identification of the source.

With this new equipment, it thus is now possible to keep a continuous running check on vibrations from every shot in strip mine blasting at a very low cost per shot even in an area like that around Hazleton, where many shots per day are fired in scattered locations. Such procedure not only would keep a full record of conformance to state regulations in Pennsylvania or operation within safe limits elsewhere, but on the constructive side it would preserve quantitative data on a waste by-product of blasting—vibrations.

Effective fragmentation with a minimum of heave

Long Life - Big Output - Economy

These three important requisites for excavator service are outstandingly filled by the Bucyrus-Erie 85-B electric shovel. The 3¼-yard 85-B is trimly designed, built of specially selected steels and alloys to insure strength and long life in every part, yet with no excess weight anywhere to slow cycle time and waste power. Bucyrus-Erie's unequalled experience in the construction of excavating machinery provides the scientific balance of speeds, power and weight placement that means smooth, fast, efficient action. Responsive Ward-Leonard variable voltage control gives the operator complete mastery of the machine for a rapid, output-boosting cycle. Machinery is easily accessible and maintenance requirements kept to a minimum, so upkeep time and costs are low. See one in action, and it's easy to understand why the "years ahead" 85-B is chosen for service in mines and quarries the world over.

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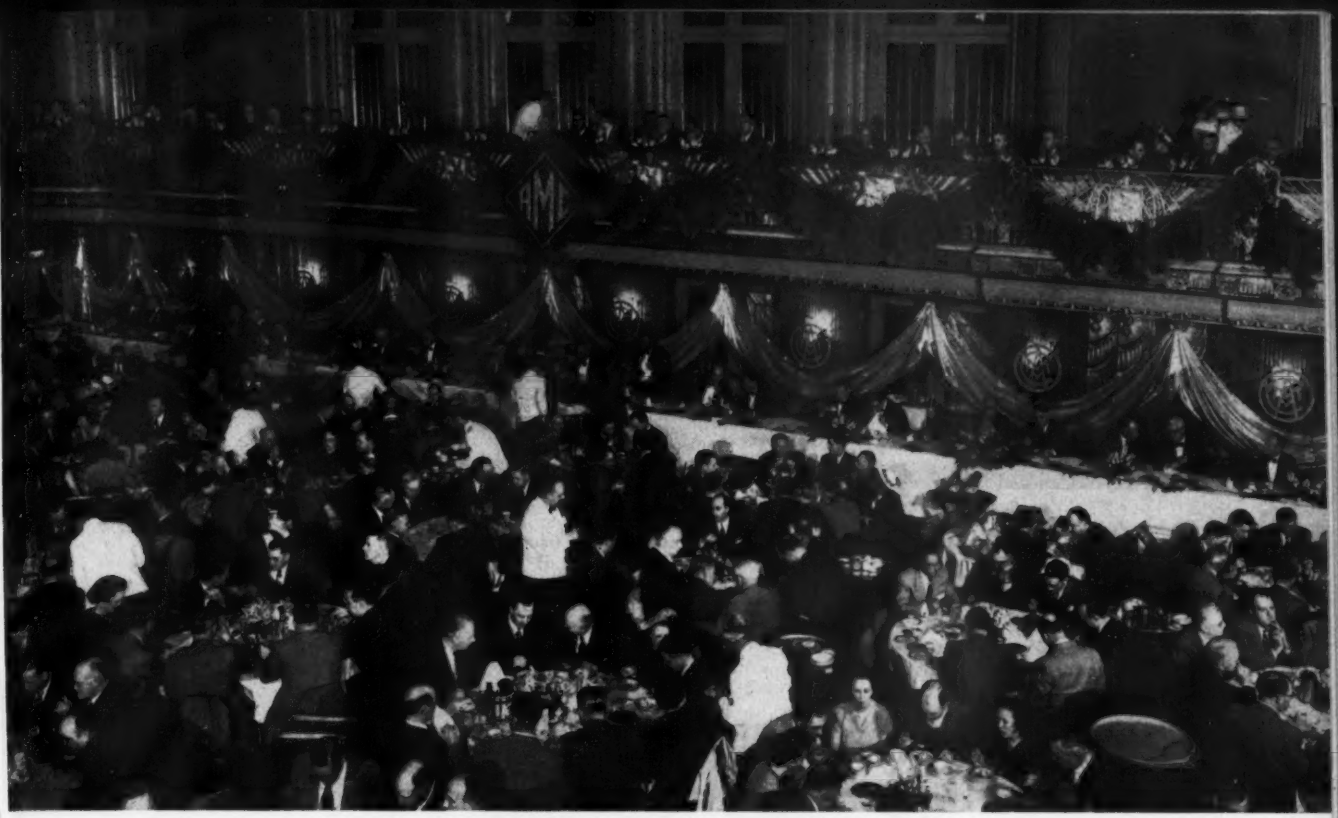


The Annual Banquet—climax of a record-breaking Convention

Record Group Attends 1950 Coal Convention

WHEN the more than 1900 coal mine operators and manufacturers' representatives met in Cincinnati April 24-26 for the 1950 Coal Convention, the "black days" of strikes and shutdowns were a thing of the past. Current problems and future plans were the principal topics of discussion on the comprehensive program aimed at greater safety and the more economic production of quality coal.

That the 1950 Convention was a singular success is proved by the unusually high attendance figures for a meeting held without exhibits. More than 1700 persons were registered in advance, thereby cutting down greatly on the time normally spent in registering. The large number that turned out for the various sessions further attested the enthusiastic acceptance and approval of the job done by E. R. Price, National Chairman of the Program Committee, and his able committee. High praise is due these men for rounding out a vitally important program of both general and specific interests covering the many varied phases of coal mining.

Senator A. Willis Robertson was welcomed to the Coal Convention by Howard I. Young, President of the American Mining Congress

When Julian D. Conover, secretary of the American Mining Congress, officially opened the Convention at 9:45 a. m. on Monday, the attractive Pavillon Caprice was filled to capacity. Mr. Conover pointed out that the 1950 Convention, the 27th annual meeting, was another step in the contributions to greater efficiency and safety, lower costs and better quality coal with which to retain and expand markets in the face of stiffer competition.

In forceful denial of misleading statements concerning the health of the coal mining industry, Mr. Conover said "each of these meetings is a living demonstration that coal is *not* a sick industry, but an alert, up-and-coming, progressive industry that can and will solve its own problems if it is just given a chance. I defy anyone to take part in these sessions, or to study the exhibits of modern cost-saving equipment shown at our Expositions—which have been developed by our private enterprise system—and then to say

Operators and manufacturers met at the Convention to discuss mutual problems

that the answer to coal's problem is government regulation, socialization or nationalization of the mines.

"An industry that is producing right now, in 1950, a tonnage of a basic commodity which exceeds by 150,000,000 tons the production of any other industry in any year of its history—and which in so doing is paying the highest industrial wages in the world, is producing three to six times as much coal per man per day as any other country, and is spending hundreds of millions of dollars in modernizing its plants and equipment—certainly cannot be classed as a sick industry.

"What the coal industry needs is not government investigation and government control, as have been proposed in certain quarters, but constructive action to give coal an even break in its effort to achieve stability—including fair tax treatment, adequate allowances for depletion and development, protection from drowning in a flood of imported oil, and application of our anti-trust laws to labor union monopoly in the same manner as the law would be applied to an industrial monopoly.

"As an industry which has never asked for nor received a government subsidy—an industry which supplies over half of our energy requirements and must be prepared to carry most of the tremendous extra load in emergency—an industry which will be vitally needed when oil and gas have passed out of the picture—the coal industry asks only for a favorable climate in which to work out its own destiny."

Mr. Conover introduced Program Committee Chairman E. R. "Jack" Price, manager of coal properties for the Inland Steel Co. Mr. Price welcomed mining men to the Convention and expressed his deep appreciation of the splendid cooperation given by the industry in building a valuable and interesting program that will contribute materially to coal's progress.

The first speaker, A. C. Spurr, president of the Monongahela Power Co., forcefully outlined the need for continually improving public relations, pointing out how the industry had done a fine job in fulfilling its obligations but had overlooked telling the public all of its major accomplishments.

Educational Programs Described

Next followed papers on educational programs to develop supervisors in which the participants were: H. C. Livingston, vice-president, Union Pacific Coal Co.; H. L. Walker, head, department of mining and metallurgical engineering, University of Illinois; and G. R. Spindler, director of the

Manufacturers Division lay plans for the 1951 Coal Show at Cleveland

school of mines of West Virginia University. The great need for high calibre supervisory personnel was discussed and some of the work was described that is now under way in training high school and engineering graduates for supervisory positions.

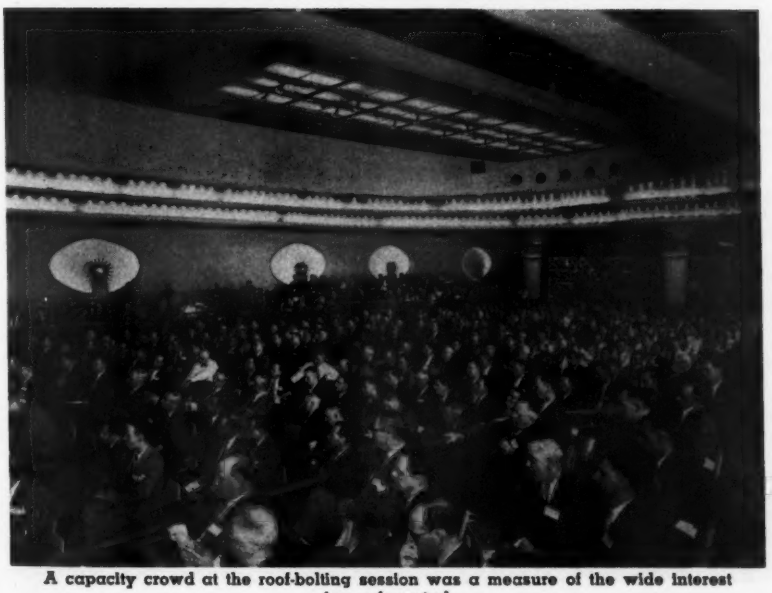
At luncheon on Monday the Hall of Mirrors was crowded to capacity with more than 600 present to hear the Hon. A. Willis Robertson, U. S. Senator from Virginia, aggressively support the American system of political-economic freedom and warn against the program of "creeping socialism" under way in the U. S. Senator Robertson spoke incisively on the fearful powers inherent in monopolies, particularly labor monopolies, and urged all Americans to join forces to assure the maintenance of liberty for future generations.

Another capacity crowd was present on Monday afternoon at the session on roof bolting, a subject of the greatest interest to operating men as a successful method of roof support. The papers presented ranged from an analysis of the theory of roof bolting through examples of a variety of actual installations. The application of the method of roof support to pitching measures in a tunnel was also thoroughly considered. Mechanical equipment required to carry on roof bolting successfully was described in the light of various local conditions.

The session on strip mining, held concurrently, included papers on power, vibrations from overburden blasting, and the advantages to be realized from radio communication to improve strip mine operations.

On Tuesday morning, sessions were held on coal drying and mine safety. These well-attended meetings brought forth the latest information in methods and equipment for dewatering and drying various types of coal to prepare marketable products. Keen interest was shown in the safety panel where various programs were described that had borne out measurable results in reducing accidents.

Chairman Dan Harrington and speakers on the well-attended safety panel



A capacity crowd at the roof-bolting session was a measure of the wide interest in roof control

Threat to Business Cited

At the Tuesday luncheon Louis B. Seltzer, editor of the *Cleveland Press*, gave a timely address on the biggest threat to American business. He expressed fear, not so much of dangers from abroad, as of those whose seed has already been sown within the borders of the United States. As a measure to defeat the trend towards socialism, Mr. Seltzer urged every American to bear his responsibility by actively participating in community life, by going to the polls, and by doing everything possible to dispel the gathering clouds that would snuff out the light of freedom.

Sessions on haulage and power, on time studies and maintenance and on strip mining proceeded concurrently on Tuesday afternoon. Large groups of interested operators, eager to learn how the other fellow meets his operating problems, came together at these meetings. The use of a-c power underground, power controls, belt haulage and track haulage, time studies for face operations, mechanical loading and service haulage were all discussed in detail. Mining equipment maintenance came in for serious study in an excellent paper revealing the real worth of an efficient maintenance department.

At the Tuesday afternoon strip-mining session the use of voltages above 4000 was fully discussed. An especially interesting talk was given on the wheel excavator for removal of various types of overburden. The economy possible in time and effort by using outside curves in stripping operations was also a feature of this session.

Pension plans for company employes were given a thorough airing on Wednesday morning. At the same time, the latest developments, at home and abroad, in coal cleaning were described at the coal preparation session. Methods of controlling gob pile fires and the experience of one company in preventing and extinguishing refuse fires were considered. Wednesday afternoon the significant topic of continuous mining was treated from many aspects. The present status and future possibilities of methods of continuous mining, together with problems of service haulage, power and ventilation, were analyzed from every angle by leaders in this new coal mining development.

Manufacturers Division Plans Ahead

On Monday afternoon the Manufacturers Division held its annual meeting to hear a report on past expositions of mining machinery and lay plans for the future. M. L. McCormack, manager of rock drill sales, Ingersoll-Rand Co., and chairman of the Manufacturers Division, presided. Secretary Conover presented a detailed report of the year's activities and outlined plans for the 1950 Metal Mining Convention and Exposition in Salt Lake City and the 1951 Coal Show in Cleveland.

Members elected to the Board of Governors of the Division to serve for a three-year term expiring in 1953 were as follows: J. H. Fulford, Jeffrey Manufacturing Co.; William E. Goodman, Goodman Manufacturing Co.; John Graham, American Steel & Wire Co.; J. W. Overstreet, National Electric Coil Co.; John T. Ryan, Jr., Mine Safety Appliances Co.; J. H. Sanford, Ohio Brass Co.; and Guy V. Woody, Allis-Chalmers Manufacturing Co.

Howard I. Young, president of the American Mining Congress, brought the members of the Manufacturers Division a message of real worth. He commended them highly for their cooperative and continuous efforts in carrying on a large share of the work of steady improvement in safety and more economic production.

Session Chairmen

High praise is due the hard-working group who served as chairmen of the many sessions. They were on hand before the specially-selected, pre-session motion pictures began and carried through in conducting the sessions according to schedule. These men who gave so generously of their time were: Frank G. Smith, vice-president, Sunday Creek Coal Co.; J. Robert Bazley, president, J. Robert Bazley, Inc.; James Hyslop, president, Hanna Coal Co.; Dan H. Harrington, former chief, Health & Safety Branch, U. S. Bureau of Mines; Davis Read, chief engineer, West Kentucky Coal Co.; Roy L. Adams, vice-president, Old Ben Coal Corp.; L. Russell Kelce, president, Sinclair Coal Co.; Hugh B. Lee, vice-president, Maumee Collieries Co.; R. H. Hughes, chief engineer, Clinchfield Coal Corp.; and M. H. Forester, vice-president, Pittsburgh Consolidation Coal Co.

As the Convention goers thronged in and out of the meeting rooms at the Netherland Plaza each day, a group of cordial, capable men serving on the Welcoming Committee greeted the registrants and directed them to the various sessions. They were headed up by the affable C. M. "Connie" Donahue, manager, mining department, Mine Safety Appliances Co.

C. M. Donahue
Chairman
Welcoming Committee

Maurice D. Cooper, National Coal Association, and his hard-working Floor Committee, carried the responsibility of seeing that the sessions went off smoothly. These men deserve a vote of thanks from the entire industry for their splendid work.

High Calibre Entertainment

Monday evening baseball fans had the opportunity to see the Cincinnati Reds play the St. Louis Cardinals, and a big crowd got together in the "Mining Congress" section at Crosley Field to see this top-notch game. On Tuesday night the traditional Coal Miners Party drew a huge gathering of nearly 850 who came to the Pavillon Caprice to relax with old friends and to make new ones. Free beer and snacks sustained the miners and a group of talented entertainers put on a splendid performance characterized by exceptional eye and ear appeal. From dance acts to high comedy the entire show was thoroughly enjoyable. This relaxing evening was a splendid occasion that gave real pleasure to all who attended.

High point of the Convention was the annual banquet on Wednesday evening when the Hall of Mirrors was the scene of the regular "speechless" banquet. Toastmaster E. R. Price presided and briefly introduced head table guests. Then the meeting was turned over to Wayne King and his orchestra and the talented entertainers in his troupe. Their splendid performance met with unanimous approval. Of special interest were the young singers, Nancy Evans and Harry Hall.

Special—For the Ladies

More than 125 ladies attended the 1950 Coal Convention. Many of them attended the technical sessions but most were drawn particularly to the special occasions arranged for their entertainment. On Monday the ladies met for a luncheon in the Skyline Room of the Terrace Plaza Hotel, and rounded out a pleasant afternoon with a conducted tour of this unique hotel and a television show.

On Tuesday the ladies gathered at the White Horse Tavern in Kentucky for a luncheon and bingo party where the winners were awarded specially-selected prizes. The ladies turned out in full force at the Coal Miners Party and at the Annual Banquet where their presence contributed greatly to the success of these fine events.

The 1951 Coal Show

Looking ahead to the 1951 Coal Show, further plans were made in Cincinnati. The exhibits and the Convention sessions will be held at the Public Auditorium in Cleveland, May 14-17. All indications point to the 1951 Coal Show as being a real success. In the face of steadily rising costs, and especially an unprecedented high labor expense, coal industry operators and manufacturers can be counted upon to continue their cooperation in an all-out effort to regain markets and make new ones by providing a steady flow of quality fuel.

Problems of open-pit mining were discussed in special sessions

Convention Papers

Digests of papers delivered at Convention sessions are presented here. Together with discussions and illustrations, they will be published in full in the 1950 Coal Mine Modernization Year Book.

Roof Bolting

Theory and Principles of Roof Bolting

By PHILIP B. BUCKY
Executive Officer
School of Mines, Columbia University

ROOF bolting may be described as a procedure for transmitting mine roof or underweight load to competent supporting beds above it. To solve the roof bolting problem on the basis of present elastic theory, the geologic section to the surface must be known as well as the elastic limit strengths of each geologic material in tension, compression and shear. The barodynamic or vertical and lateral earth forces must also be determined. With the above data, one may calculate: (a) the underweight for any given span; (b) the maximum open span possible to work; (c) the lateral distance between roof bolts; (d) the competent beds in which to anchor bolts; and (e) the bolt strengths.

Theory and mathematics inform us: (1) how much sag or deflection may be expected in a mine roof provided it is stressed within the elastic limits; (2) that the sections of maximum stress are in the underweight and are immediately over the ribs and that here is the first place of failure; (3) that stresses in the mine roof center are one-half those at the section over the ribs and that when these are visible to an observer the roof has already failed over the ribs. Elastic theory tells us where a structure may start to fail, but does not tell us how that failure will progress or what its final form will be. The solution of problems not amenable to presently known theory and mathematics is generally obtained by means of models, as a scalar model made in every part of the same material as the prototype will behave similarly to the prototype if its effective weight is increased in the same proportion as its scale is decreased. The effect of an increase in weight may be obtained by substituting a centrifugal for a gravitational field.

There is thus made available a procedure for attacking mine roof problems not amenable to solution by elastic theory. Whether the answer to these will be roof bolting is as yet too soon to answer, but the indications are that roof bolting may prove most applicable in many cases.

Successful Practices in Alabama

By E. H. STEVENS
Project Engineer
Tennessee Coal, Iron & Railroad Co.

OUR company today has over 5,000,000 sq ft of mine roof supported entirely by bolting or, in other words, about 50 miles of entry 20 ft wide. Roof bolting has meant a great deal to our company as, in our coal mines, the standard system specified timbers on a maximum of 4-ft centers. In many sections, closer spacing was needed together with extra heavy timbering, crossbars and lagging.

In deciding bolting procedure, several factors had to be considered in relation to each other, as there is no known method to determine actual roof load carried by any timber set or roof bolt. Therefore, it was necessary to develop from trial and test the most effective anchorage and then determine the bolt spacing required for a desirable factor of safety. The specifications now in use place bolts on 4-ft centers each way; all are installed vertically and the length varies from 30-48 in., depending on seam height and overlying strata.

As experience is gained, techniques will be improved. Torquometer readings are being taken for spot checks on the condition of bolts. Investigation of roof strata by diamond drilling is continuing, and as soon as it is available, the stratoscope being developed by the U. S. Bureau of Mines will be employed as an aid to determine the best anchorage level in each working place. Each roof failure is being investigated and the information obtained is adding to the store of knowledge regarding this new method of roof support.

In 1949 the coal and ore mines achieved their best all-time safety record. Much of the improvement can be attributed to factors peculiar to roof bolting, such as reduced quantities of roof support materials to be handled, reduced amount of rock to be barred down, elimination of the hazard of knock-out timbers and cross-collars, and better roof protection at the face. Better roof control has greatly decreased injuries due to rock falls.

Application of Roof Bolting to Steeply Pitching Measures

By D. E. INGERSOLL
Division Superintendent
The Philadelphia & Reading Coal & Iron Co.

PERHAPS the most extensive application of roof bolting in pitching measures is that initiated by the Philadelphia & Reading Coal & Iron Co. in the development of its Porter Tunnel. This tunnel, 14 ft wide in the clear, is driven into measures dipping in the same direction on an inclination of 70-85 deg and will ultimately reach 4200 ft in length, cutting the opposite dip measures of the same basin.

At a point 482 ft from the portal, the ground appeared to be sufficiently firm to proceed without timbering, and, although the bedding planes are well defined, the measures were confused in spots. No falls of top had occurred, but there was a scaling action that required continual and repeated dressing down. The conditions led to the consideration of a bolting program, and after careful study of the roof conditions and the action of the ground then opened, the following plan was adopted: (1) bolts 5½-6½ ft in length to be applied on 4-ft centers; (2) standard drilling to be at 60 deg from the horizontal in order to more nearly cross measures at right angles; (3) bolts to be 1 in. in diameter, of the split and wedge type; (4) triangular plate, approximately 10 in. on each side, to be used for bearing plate.

All bolts were applied with torquometer readings within recommended minimum and maximum limits, and after two months' elapsed time, check readings were taken on 13.4 percent of the bolts in place. Of this number of bolts, 27 percent showed no change, 37 percent gave a plus and 36 percent a minus reading, the variations in either direction, however, amounting to approximately 10 percent.

In conclusion, it is our considered opinion that roof bolting in this particular instance afforded an adequate and efficient method of promptly and economically securing the roof, enabling advance at the rate of 16-17 ft per day, a rate which would not otherwise have been attainable. Up to the present time there is no indication that the auxiliary support has been subjected to any load by failure of the roof bolts to provide the necessary support.

Wooden Pins for Roof Control

By STERLING S. LANIER, JR.
President
Norton Coal Corp.

A BAD roof condition, consisting of a tender shale as much as 5 ft thick, made it imperative to devise some method of support other than conventional timbering. Roof bolting was first considered but prevalent acid water seemed to indicate that steel rods would have a short life. Accordingly, the idea of using wooden pins was conceived and trials were started. Pins of varying lengths, cross-section and diameter were tried, and the present method uses a 2⅝ in. round pin in a 3 in. diam hole. This actually gives a tight fit.

In this way, the wooden pin has a slightly different action than that of the usual steel rod. The rod depends on an anchor—either the wedge or the expanding sleeve type—at the top of the hole, while the wooden pin has no such anchor but depends entirely on friction between wood and the rock strata for the entire length of the hole. An important factor is to set the pins in the roof immediately after the place has been cleaned up and before any deterioration of the roof rock can start or the roof beam to sag. Also, the holes are now drilled on an angle of about 45 deg.

Roof supported with pins cost less than the conventional method of posts and crossbars. At this mine there are approximately 5100 ft of entry roof supported by 3800 wooden pins that cost approximately $1,140. Conventional timbering would have required 1700 crossbars with 3400 posts at a cost of $6,290 for material. With conventional timbering a crew of five men was needed as a regular part of a mechanical loading operation; with pinning the crew is reduced to three men.

It has been argued that only straight grain wood should be used, but experience does not bear this out. We use any hard wood, generally oak, buying mill run but without any wind shaken or unsound pieces. No harmful effect has been observed from knots or other minor imperfections in the wood, indicating that the tensile strength of the pin material is not a determining factor.

Roof Bolting to Prevent Accidents

By E. M. THOMAS
Chief, Roof Control Section
U. S. Bureau of Mines

IN 1949 approximately 200 coal mining companies were using roof bolting to support about 14,000,000 sq ft of roof surface. Virtually all of the mechanized mines in the United States were planning experimental installations, refuting any thought one might have that the bituminous coal industry is reluctant to accept new ideas. Because of the sudden acceptance of roof bolting, the technical personnel of the roof control section of the Bureau of Mines has been increased from 3 to 14 and our greatest task has been to train new field men rapidly to meet the demands for service and advice by the coal operators. Preliminary installations show considerable promise, but for the sake of safety, the roof bolting problem must be worked out at each mine by experiments using conventional timbering during the trial period.

To date, one accident in which three men were killed can be attributed directly to roof bolting, and three other accidents involving fatalities in mines using roof bolts were due to the causes familiar to all of us—"the man did not set a safety post before he worked under unsupported roof near the face," or "the supports were not installed according to the system laid out." Following basic factors should be recognized and observed where roof bolts are used:

(1) Roof bolts are not "sky hooks," and they do not eliminate the weight of the roof; they merely change the distribution of stresses.

(2) The load-carrying capacity of any beam is limited; consequently, if a bolted roof (beam) will support a span 25 ft wide, it may fail if this width is exceeded.

(3) Unless it is intended to install bolts with proper supervision and close inspection, roof bolting should not be attempted. Improperly installed bolts are as dangerous as no support at all.

(4) The roof between the last row of bolts and the face is an unknown factor until it is actually secured; anyone who must work in this area should be protected by safety posts.

Mechanical Equipment for Roof Bolting

By T. H. TROLLER
Vice-President, Engineering
Joy Manufacturing Co.

IN view of the newness of the method of supporting mine roof by means of roof bolting, the designer of mechanical equipment is confronted with the need to prepare designs for which no definite specifications are as yet written. The equipment required will consist of drills, bolts, and means to secure bolts in the roof holes. Beyond this general and established fact, the variety of conditions and the existing conceptions are wide. We are confronted with different rock formation and with rooms and entries of various widths. These conditions will have an effect on the lengths of the roof bolts, the spacing and sometimes on the required direction of drilling. Beyond that, the diameter of the hole may vary depending on the type of bolts preferred and the type of bolt in turn may vary depending on the permanency of the setting, moisture conditions, and again firmness of the roof.

We have further differences in the requirement for bolts to be set immediately at the face perhaps by means of the attachment of drills to such other pieces of equipment as timber setters, coal drills, cutting machines or continuous miners, or the preference for an independent piece of equipment that may be used between shifts or between the main mining operations at the face. We have to choose in the drilling equipment between rotary and percussion types and between wet or dry dust abatement, and finally between high cost equipment of high efficiency and lower cost equipment of lower efficiency, depending on the over-all conditions prevailing in an operation.

In making his decision the manufacturer will be guided by various experiences and data of the part art. But most certainly, the development is not frozen and we may expect, for some time, a gradual change of equipment and perhaps even some revolutionary jumps as new ideas and inventions make themselves felt.

The suppliers of mining machinery and equipment are hard at work to develop the means which will permit the miner to take full advantage of the safety and economy inherent in roof support by bolting. The variety of equipment that is or will shortly be at the disposal of the mines should be in keeping with the variance of the existing mining conditions and will in addition leave a good leeway for the personal initiative and preference of the operators.

Continuous Mining

Progress of Continuous Mining

By GERALD VON STROH
Director, Mining Development Committee
Bituminous Coal Research, Inc.

PROJECTED cost studies, which are always subject to criticism, indicate that if continuous mining developments progress at the same rate as in the past years, cost reductions in the order of $1 to $1.50 per ton can be achieved within the next decade. This cost will not be attained automatically, but considerably more planning and attention on the part of administration and engineering will be required.

The points that must be considered in the further use of these machines are: (a) transportation, which is a problem fully as complicated as the mining machine and is of secondary importance only because the continuous mining machine creates the need for continuous transportation; (b) roof control should have a thorough revision and streamlining; intensive research is indicated and the work of the U. S. Bureau of Mines should be broadened and extended; (c) power requirements are apt to increase rather than decrease, and particular attention should be paid to substations and general distribution; considerable thought is being given to high voltage power; (d) water spraying is required in most states and for practical purposes is a "must."

The Mining Development Program of Bituminous Coal Research has produced a test machine that has actually mined at the rate of two tons per minute with a maximum consumption of 25 hp. Test unit No. 2 will soon be ready—this is a low version, 20 in. in over-all height, and will make a cut 10 ft wide and retract to 7 ft. However, it should be pointed out that it will require between two and three years before these machines are ready for commercial utilization. To cover the interim period, we feel that a conventional loading machine can be modified to use the same principle and if tests to be made this summer are successful, this model would be turned over to manufacturers for commercial production.

Operating with the Continuous Miner

By WILLIAM E. HESS
General Superintendent
Vesta-Shannopin Division, Jones & Laughlin Steel Corp.

MR. HESS' paper appeared in full in the May issue of MINING CONGRESS JOURNAL.

Continuous Mining in Illinois

By FRANK EUBANKS
Superintendent, Mechanical Maintenance
Old Ben Coal Corp.

THE Old Ben Coal Corp. installed its first continuous miner in February 1949. Then in December 1949 the second machine was installed that had quite a number of improvements over the first model. The third continuous miner is now in operation, and has still further improvements that have raised the operating efficiency of the unit and have improved the size consist. An item of special interest is the favorable maintenance cost as compared to the cost in a mechanical loading section. For the year to date, labor, supplies, lubrication, dust control and bit sharpening for the continuous miner is $0.1413 per ton, while the maintenance cost on a mechanical loader section has been $0.1407 per ton.

The requirements for dust abatement is higher than in conventional mechanical loading sections. For each miner we have two 1800-gallon water tanks, a turbine pump and a tank with a pressure switch. Water is piped from the pump as close as possible to the machine through a 1-in. pipe, then through a 1-in. hose. A machine has eight cone-spray nozzles—four of these are above the ripper bar and four are below, using a total of five gallons per ton of coal mined.

Good power is of utmost importance in continuous mining. Demand records show a root-mean-square average of approximately 85 kw with occasional 200 kw peaks for a 30-second period. A 300-kw substation should be adequate for two continuous mining units providing, of course, that feeders and cables are of adequate size.

Experience to date indicates that continuous mining is an accomplished reality and that substantial cost savings can be effected. How great these savings will be and to what extent continuous mining can be applied will, of course, depend on future improvements and further developments.

Operating With the Colmol

By W. J. PHILLIPS
Assistant to President
Sunnyhill Coal Co.

FOR the past eight months, the experimental model of the Colmol which was on display at the Coal Show in Cleveland, has been operating in the Upper Freeport seam. which has an average height of 48-51 in. of a woody fibrous structure coal. This being a new mine, only development work has been done, driving three main headings. The machine takes a 9 ft cut, but the entries are driven about 12 ft wide. This is done by advancing the 9 ft width for a distance of 15-20 ft; the machine then goes back to the beginning of the cut and takes a 2½ ft lift off one side, thus widening the entry to 12 ft.

Two shuttle cars are used for haulage from the machine to a 30-in. belt conveyor for transportation to the outside. Usually one car is kept behind the machine as a surge bin while the other shuttles to and from the belt loading point. The machine makes a smooth level roof and timbering is provided by cross bars supported on jacks set on an angle in against the rib. The arched effect of the roof at the rib tends to improve the roof action. The dust was handled by a series of umbrella sprays on top of the upper gear case at the front of the machine and two other rows of sprays above the conveyor to trap what dust escapes.

Our regular crew consists of five men; one machine operator, two shuttle car operators, a timberman and a utility man. The average production for a 7-hr shift at the working face was 225 tons although time studies showed the Colmol to be digging only 33⅓ percent of the shift. As this was still an experimental unit, considerable productive time was taken by development work on bits for hydraulic and electric readings and almost daily demonstrations to groups of coal operators.

A new operation has just been started in the No. 6 middle Kittanning Seam in southern Ohio. This seam is 48 in. in height and in addition, 12 to 14 in. of bone will also be mined. From observations so far, we anticipate in this operation a production at the rate of three or more tons per minute.

Service Haulage for Continuous Mining

By M. F. CUNNINGHAM
Sales Manager
Goodman Manufacturing Co.

IF a continuous mining machine is to be truly continuous, coal must flow from it without interruption, but so far this has been difficult to accomplish. Due to the rapid rate of advance, the haulage distances change materially during a shift; mining conditions may also vary and either of these conditions can cause a stoppage in the transportation and consequently in the operation of the machine.

The two types of equipment in general use today for service haulage are shuttle cars and shaker conveyors. In some systems the shuttle travels from the machine to the intermediate haulage in the conventional manner used with caterpillar loaders, but in other operations, one shuttle stays at the boom of the machine serving as a surge bin and loads into another shuttle that transports to the belt or mine car. A modification of the surge idea is to have the continuous machine discharge directly onto the mine floor where the coal is picked up by a caterpillar loader and transferred to a shuttle that hauls to the main transportation system. Each of the foregoing systems has the advantage of easy portability, but each involves a rather high investment cost.

Another method is to employ a shaker conveyor with duckbill loader. A 45 deg swivel and the ability to extend the telescopic trough for a distance of 26 ft gives this equipment considerable flexibility. It has the further advantage of operating successfully over a soft fire clay bottom and its cost is comparatively low. However, adverse grades decrease its capacity and there is the further disadvantage that results from the necessity for moving the drive head after an advance of about 300 ft.

Although all of these methods have had some degree of success, it is generally recognized that each type of equipment has its limitations and is not "truly continuous," and none are especially well adapted to pillar drawing. However, their operation has served to show what is needed in the way of transportation and experiments now in progress will undoubtedly develop haulage equipment more nearly suited to continuous mining.

Power for Continuous Mining

By R. M. HUNTER
Electrical Engineer
Rochester & Pittsburgh Coal Co.
and
C. E. HUGUS
Electrical Engineer
Reliance Electric & Engineering Co.

THE use of continuous machines will lead to more concentrated mining. This will increase the problems connected with the power supply. Coordination of mining plans and power supply plans will be essential, but each installation will be a separate problem until sufficient experience is gained to permit standardization. Power requirements may be considered in two ways: first, peak load; and second, what might be called "effective" load. Peak load will determine the copper in the distribution lines and the effective load will be the factor determining the size of the conversion unit with peak loads as a secondary consideration.

Estimated average power requirement for continuous operation will be approximately 450 amp at the machine or about 100 kw. Peak power requirement at the substation would be about 215 kw, which is less than 50 percent overload on a 150-kw conversion set, hence a 150-kw unit is adequate for one continuous unit and 300-kw unit for two. In one case, four machines and the main line haulage were supplied from a 500-kw station, but this was somewhat overloaded at times.

Experience so far seems to indicate that 750 amp can be assumed as the peak current requirement for one continuous machine with two shuttle cars. If this load were supplied over a 500,000-cir mils feed and return, the minimum voltage could be maintained approximately 2500 ft from the substation; with 1,000,000 cir mils the distance would be 5000 ft.

With any type of conversion equipment for continuous mining, there are three important considerations: (a) reliability, (b) voltage characteristics and (c) mobility. Converters, motor generators and mercury arc rectifiers have been in use for many years and have well known characteristics. Two newcomers have entered the field—the selenium rectifier and the new mechanical rectifier, but have not yet had sufficient use underground for discussion here.

Disturbances in the a-c supply line, other than a complete failure, have varying effects on these conversion units. All can and should be protected from lightning; sudden surges of voltages will be reflected to the d-c system through the rotary converter and any type of rectifier and may cause d-c motors to flash over. The motor-generator set is not subject to this fault because the driving motor absorbs sudden increases and decreases in supply voltage. All units are available with warning or protective devices to guard against major failures.

The rate at which coal is removed from the face by the continuous miner is materially affected by the voltage supplied to the machine. This fact has always been well understood and taken into consideration in the operation of the conventional mechanical loaders. The need for excellent voltage characteristics for the continuous miner is clearly and forcefully appreciated, upon observing the drop off in speed that occurs as the load current increases. Also, low voltage on the main motor will cause a stall condition to develop, that decreases the productive rate of the machine. For these reasons the ideal power source for continuous mining should have rising voltage characteristics to compensate for the drop in the feeder and cable so as to maintain rated voltage at the machine.

Ventilation for Continuous Mining

By RUSSELL HERBY
In Charge, Safety Dept.
Pennsylvania Coal & Coke Corp.

ONE of the problems that is accompanying the development of continuous mining is to supply adequate ventilation to the working face. There are a number of requirements to be met which necessitate some changes or modifications in conventional ventilation procedure. The fast rate of advancement and the continuous exposure of fresh coal faces may be attended by encountering excessive quantities of methane, although this has not always proven to be the case. Then, other physical conditions such as roof, moisture and character of the coal as affecting the amount of coal dust formed, all have some bearing on the ventilating method.

The Coal Division Committee on Ventilation is making a special study of the subject but will not attempt to set up any standards or recommended practices. They will first cover methods and techniques already in use. As a first step in this investigation, seven continuous mining operations have been selected. None of these have had a long record of experience, but all have proceeded far enough to have indicated certain fundamental ventilating requirements. The seven operations are all engaged in entry development; the general plan is to drive one heading a relatively short distance—about one breakthrough length, then change over and advance the adjoining places the same distance.

In all of these mines the continuous operation is on a separate air split. Line brattices are used to take the air

from the last breakthrough up to the working face and, in most cases, fresh air is brought in over the machine and returned behind the brattice. This increases visibility at the working face and safeguards against possible methane and dust being carried back over the machine.

The amount of air used varies from 6000 to 15,000 cfm in the different operations. All use water sprays on the machine from 135 to 550 psi. The amount of water varies from 5½ to as much as 11 gpm, but in the latter case, additional sprays have been installed behind the brattices to take out any dust that may have passed the machine sprays.

Coal Preparation

Latest Developments and Trends in Coal Preparation

By A. C. RICHARDSON
Supervisor, Minerals Processing Division
Battelle Memorial Institute

A NUMBER of important things are happening in coal preparation, but these developments all take time and there is nothing of a new or spectacular nature to report. However, all of these developments have one purpose which is to help coal hold its competitive position by improving quality.

With full-seam mining, removal of coarse rock is a problem; oscillating or sectionalized picking tables are used and the Bradford breaker still remains a good machine for handling over-size refuse. For cleaning coarse coal the present trend is toward Baum type jigs and Heavy Media separators, partly because of the large tonnages they can handle. Present mining methods produce a large percentage of minus ⅜-in. coal and for these small sizes, both dry and wet screening are used.

Dry cleaning equipment is being improved and with properly prepared feeds will perform satisfactorily. Recently the tendency has been to increase the range of sizes cleaned with air to above 1 in. Wet cleaning of fine coal is more difficult. The coal table is still one of the most efficient methods and is in demand where small tonnages are involved, although recent installations for large tonnages have been made. Launders have been developed to treat large tonnages and better feed and water distribution is provided so that both tables and launders can make more efficient separation and are able to meet changing market conditions.

The Dutch cyclone is being put to a great many uses; as a classifier it separates coal and refuse from a middling product from other cleaning units, and it may also be used to thicken coal as fine as 200 mesh. Probably its most unusual development is in the cleaning of fine sizes with finely ground magnetite as a medium. Flotation has obtained a real foothold in coal preparation, and is a logical method for treating extremely fine sizes.

Drying by Centrifugal Dryers and Filters

By L. O. LOUGEE
George S. Baton & Co.

MECHANICAL aids in the drying of washed coal have a history dating back about 30 years with the first use of centrifugal force and filters. Since that time a number of machines have been designed and the industry now has a choice of several makes of vertical basket types, solid bowl centrifuges, in addition to horizontal centrifuges and continuous filters. The top size of fine coal is usually minus ⅜ in.; this holds moisture between the particles and its removal is sometimes difficult. The usual custom is to separate the ⅜ by 0 into two sizes, screening at ⅛ in. or 1/16 in., depending on the quality and the characteristics of the coal.

The requirements of a good mechanical dryer are:

(1) The ability to lower moisture content to within limits of the customer's specifications
(2) The capacity to handle and process high tonnages
(3) The ability to handle large tonnage with the minimum amount of friction and degradation
(4) The ability to handle large quantities of water
(5) To provide automatic operation for the whole series of processes necessary to produce a dry product

The several types of mechanical equipment now on the market (not including thermal dryers) designed to fit the dewatering requirements of different coals consists of centrifugal dryers and filters. The three centrifugal dryers—the CMI, the Carpenter and the Bird—all use the same principle; high speed rotation, developing sufficient centrifugal force to throw the coal and water against a fine screen through which the water passes leaving the dried coal on the inside. In all cases, the process is continuous.

Filters are used to dewater fine coal slurries from thickeners and froth flotation concentrates and the filtered product usually requires further drying efforts if it is to be loaded without mixing with other coal. The filters are usually of the pressure or suction types; some are intermittent, but the continuous suction type predominates for commercial use in the United States to filter coal slurries.

Mechanical Drying at East Diamond

By F. R. BUCKLEY
Preparation Engineer
and
GEORGE W. LAND
Director of Research
West Kentucky Coal Co.

THIS plant, located in western Kentucky, has special facilities for treating and drying the fine coal. The minus ¼ in. is removed from the raw feed and passes to two 6-ft hydrotators that separate it at plus 10 mesh. The overflow goes to the CMI dryer; the underflow passes to a classifier that takes out the plus 28 mesh and it joins with the plus 10 mesh at the dryer. Facilities are provided for separating the dried product into two sizes—¼ by 10 mesh and 10 by 28 mesh. These may be loaded separately or together, or either one or both may be blended with the larger sizes for loading. The performance during a recent 30-day period is shown in the following screen analysis:

TABLE I
AVERAGE SCREEN ANALYSES OF 21 SAMPLES

Size	¼ × 10m Dryer Feed	¼ × 10m Product	10 × 28m Dryer Feed	10 × 28m Product
+ Mesh	8.56	2.98		
4 × 10 Mesh	69.29	44.85	12.68	8.78
10 × 28 Mesh	14.88	30.82	57.87	56.21
28 × 48 Mesh	3.19	10.56	17.95	22.26
— 48 Mesh	4.08	10.79	11.50	12.75
	100.00	100.00	100.00	100.00
Average Surface Moisture.	18.56	5.15	28.97	7.92
Average Ash	7.08	6.71	7.93	6.47

A close check is kept on the dryer performance by a regular schedule of sampling the feed and the product from each unit. Although continuous inspection with the proper preventive maintenance is high compared to other equipment in the cleaning plant, it is really not excessive in view of the results obtained.

Mechanical and Thermal Drying

By F. P. CALHOUN
Assistant Production Manager
Rochester and Pittsburgh Coal Co.

A CLEANING plant that has recently been completed uses several types of mechanical and thermal methods to dry 1 in. by 0 coal. The mine is in the Upper Freeport seam and the cleaning plant is designed to prepare high-quality steam and by-product coal. The first step in the flow process is to crush the ROM to 5 in. top size; the product is then separated into 5 by ⅜ in. and ⅜ in. by 0 by wet screening. The 5 by ⅜ in. is washed in a Chance cone and the ⅜ by 0 fines are treated on Deister concentrating tables.

The cleaned ⅜ by 0 is sluiced from the tables to a Robins Dewaterizer; the feed to each screen is 67 tons per hour of coal and 200 tons per hour of water. The overproduct contains an average of 7.5 percent moisture and is taken, along with other sizes, to the thermal drier. The through product from the dewaterizer contains 30 percent moisture and passes through CMI centrifugal driers that bring the moisture down to an average 10 percent. This coal is also taken to the thermal driers.

Thermal drying is done by Raymond flash driers and McNally-Vissac screen driers. The feed for the McNally-Vissac is 60 tph of 1 in. by ⅜. Experience has shown that prior dewatering is relatively unimportant but a minimum of undersize is desirable for a good performance. The dry coal is 120 F and contains 2 percent surface moisture.

The flash drying system treats ⅜ by 0 coal. The average moisture in the feed is from 9½-10 percent and each drying column has a feed of approximately 65 tph. The moisture in the dried product is controlled and at this plant an end content of 3 percent is maintained. Below this point the coal becomes excessively dusty and above it the coal tends to pack in the railroad cars.

The complete drying system evaporates around 16 tons of water per hour, which explains why it is impractical to operate the cleaning plant in a totally closed circuit at all times. This installation was put into steady operation in January 1949, and has proved that, with equipment now available for dewatering and heat drying fine coal, a plant can be designed and operated to make a product satisfactory for the market.

Drying Fine Coal at Island Creek

By F. C. MENK
Director of Engineering
Island Creek Coal Co.

THE paper describes the dewatering and drying processes and equipment used at an Island Creek Coal Co.'s plant that was placed in operation in 1948. Except for strikes and holidays it has operated continuously since its installation and is now on a routine basis, turning out a uniformly well prepared low ash, low sulphur and low moisture product. A recent analysis of 75 samples of cleaned ¼ by 0 showed 5.36 percent ash and 3.0 percent surface moisture.

The plant is designed to prepare about 70 tph of ¼ by 0 coal by wet cleaning with a water system as nearly closed as practicable. The cleaning process is a hydrotator classifier washer combination which uses less than 300 gpm of circulating water. For dewatering and drying, the cleaned coal is separated into plus and minus ⅛ in. The ¼ by ⅛ in. coal is dewatered on a vibrating screen mainly to avoid breakage common to a more or less degree in centrifugal dryers; the minus ⅛ in. is handled through a Bird filter. The filter has proved a satisfactory unit; the the effluent containing about 7.26 percent solids is reused in a substantially closed system without additional treatment. The filter cake amounting to approximately 49 tph has about 16.65 percent surface moisture.

The solid coal discharged from both the filter and the dewatering screens is mixed and conveyed to the Raymond flash dryer for thermal drying. This has proved a useful and valuable unit, and has exceeded promised performance and capacity. Coal from the wet feed bin is fed into the drying column at a uniform rate by a screw conveyor, which also functions as an air-lock. In the column, the coal is met by a hot gas stream with a temperature of 900 F traveling up the stack at a rate of about a mile a minute; most of the individual coal pieces are dried at contact and lifted by the gas stream into a 16-ft diam cyclone where the dried coal is trapped out and discharged through an air lock. Clotted coal that may be too heavy to rise will drop into a gas mixing bowl at the column base where turbulence breaks the clots and the now smaller pieces join the gases in their upward travel into the cyclone.

Dewatering and Drying Fine Anthracite

By W. T. TURRALL
Preparation Engineer
Lehigh Navigation Coal Co., Inc.

A NUMBER of factors have influenced the operator to consider the recovery of coal of extremely fine sizes which, for years, was regarded as a waste product. These reasons may be summarized as follows: (1) the development of modern burning equipment that tended to increase the consumer demand for a low cost industrial fuel, in competition with oil and natural gas; (2) the increased mechanization in coal mining that produced a greater percentage of fines in the breaker feed; (3) the economic justification of increasing coal recovery in present operations as well as from silt banks, and waste coal storage banks; (4) the advancement in the art of fine coal beneficiation; (5) the enforcement of State Anti-Stream Pollution Legislation.

Moisture associated with coal may be divided into two important parts—surface and inherent. Surface moisture is that which is on the coal faces, or retained in cracks or fissures of the coal substance, and also includes moisture filling the voids between the particles and is not in actual contact with the coal. The number of particles calculated for the various sizes of anthracite is shown in the following table:

Size of Coal	No. of Particles Per Lb
—9/16+5/16	877
—5/16+3/16	4,012
—3/16+3/32	24,520
—3/32+3/64	195,535
—3/64+40 mesh	1,548,390
—40+200 mesh	34,892,310

These data indicate that as the particle size decreases, the number of particles per unit weight increase with a similar increase in surface area and is further evidence that moisture content varies directly with particle size. A fact already well established in operating plants is that the finer the size to be dewatered, the more difficult should the problem become; therefore it is quite possible that the method of preparation may have a direct bearing on the dewatering and drying problem.

Note: The paper then gives detailed laboratory and operating data on the use of various dewatering methods—(1) Natural or gravity drainage; (2) Mechanical methods, and (3) Thermal drying.

Recovering and Desliming Fine Coal

By R. L. SUTHERLAND
Combustion Engineer
Truax-Traer Coal Co.

MR. SUTHERLAND'S paper appears in full on page 48 of this issue.

Sludge Recovery at Peabody Coal Co.

By JOHN L. ERISMAN
Manager, Dryer Dept.
Link-Belt Co.

A SLUDGE recovery plant has recently been put into operation by the Peabody Coal Co., Harco, Ill. Most coal companies due to the lack of proper facilities of preparation, have wasted the slurry, but the Harco plant has applied a multi-louvre drying unit to excellent advantage in recovering from their dump piles a pulverized fuel for use in public utility plants.

The slurry pile is 45-60 ft high and extends over an area of approximately 35 acres. The greater percentage of the slurry is minus 28 mesh, though there is some plus 28; the moisture varies somewhat, depending on the position of the coal in the pile, that is, whether it is near the top or bottom, and also on the weather. The moisture may be as much as 25 or 30 percent, or may be as low as 17 percent total. It was desired to dry it down to 9 percent total or about 1 percent of surface moisture.

The recovery plant was designed to have a dried coal discharge of 35 tph which would mean an evaporation of 15,500 lb of water when the moisture in the feed was at 25 percent. A test run with the dryer operating at this capacity shows the following data:

Feed moisture, 20 percent average
Discharge moisture, 8.67-8.97 percent
Inlet temperature 500-600 F
Exhaust temperature 185-200 F
Feed temperature 45 F
Discharge temperature 125 F
Temperature of coal loaded 75-95 F

The recovery plant has a connected load of 189 hp and is operated by three men including loading of the railroad cars. The cost of drying coal after delivery to the recovery plant (including depreciation and maintenance) is approximately 30¢ a ton. At this cost, many tons of fine coal in the tipple wash water that was formerly a complete loss is now converted to usable pulverized fuel.

European Trends in Coal Cleaning

By JOHN GRIFFEN
Consulting Engineer
McNally Pittsburg Mfg. Corp.

THE trends in coal cleaning in England are somewhat different than in the other countries due to the differences in the size consist of the run of mine and also because much of the English market has been accustomed to coals of quite low ash content. At present in England there are about 800 preparation plants with an annual output of something over 200,000,000 tons. Until recently few plants handled as much as 600 tph and the great majority had capacities less than 200 tph. The National Coal Board has given considerable study to this, and a capacity of 800 tph seems to be favored for new plants.

Provision is made to clean by heavy medium processes as much of the lump as is practicable to eliminate or reduce the labor required for hand picking. A trend toward medium processes to produce the low ash coals above 1 in. in size demanded by the English coal markets is evident. In recent years froth flotation of slurry has come into use. The bituminous coals of South Wales and the Durham gas coals are actually suited to such cleaning and can handle coal as coarse as ten mesh.

In western Europe due to the smaller amounts of coarse coal in the run of mine there has been less interest in mechanical cleaning of coal larger than 3 in. In the preparation of western European coals the main job is cleaning the minus ½ in. which usually amounts to from 50-60 percent of the ROM. For this size, the usual practice, as it has been for years, is to use Rheolaveur or multipple cell jigs with, or without, a feldspar bed. In many cases it is necessary to make a middlings product which in most cases is from 30-40 percent ash and is utilized as fuel in the mine boiler plant.

For dewatering fine coal, practices are quite varied. In Germany, France and Belgium, drainage bins are mostly used while in England and Holland centrifugal dryers are more common. The trend in the Ruhr District of Germany is toward a more careful desliming of the fine washed coal to promote more rapid and complete drainage to about 10 percent moisture.

Refuse Disposal

Controlling Gob Pile Fires

By HENRY F. HEBLEY
Director of Research
Pittsburgh Consolidation Coal Co.

ACTIVELY burning piles of mine refuse present a difficult situation. Many have been on fire for years with little or no attempt made to extinguish them and quite often combustible material from the mine or tipple is added continually. A number of surveys are now being conducted, and it is hoped that all coal mining operations will cooperate to the fullest extent in describing, clearly and frankly, the methods that have been adopted for fire prevention and what measure of success has been attained. A clearing house is needed whereby the knowledge and experience of the various segments of the industry may be studied.

Methods differ greatly and have met with varying degrees of success. In one case limestone grout was "needled" into the ground around the foundation of a building that was threatened with destruction due to the burning of the refuse pile on which it was built. In this case the method was successful although somewhat costly. Crushing, compacting and sealing the edges of the refuse pile with clay or earth have met with considerable degrees of success where the terrain is such that this method can be used.

There is little doubt that the trend in public thinking is toward control of atmospheric pollution resulting from burning piles. Legislation at the state level has been adopted or proposed in California, Pennsylvania, West Virginia, Maryland and Massachusetts.

Allegheny County in Pennsylvania has adopted ordinances governing "open fires" under which burning gob piles are required to conform. This, in effect, establishes a research program for a period of five years to investigate and report on practical solutions for extinguishing any burning pile as well as on practical solutions for stocking refuse with a minimum danger of spontaneous combustion. Reports are required by the coal company, giving complete data as to material burning, cause of fire and an estimate as to when such fire will be extinguished.

Preventing and Extinguishing Fires in Refuse Banks

By E. T. POWELL
Chief Engineer
Susquehanna Collieries Division, The M. A. Hanna Co.

THE firing of Anthracite refuse banks is a problem which has been present for many years and has not yet been satisfactorily solved. Investigations on 34 fires have indicated a number of reasons and causes for ignition; height of the dump does not seem to be a factor as in this in-

vestigation the banks reported as igniting ranged from 60-198 ft. The material composing the banks consisted of breaker refuse, rock and silt—sometimes singly, but in most cases in combinations of two or more of these materials. An examination indicated rather conclusively that a mixture of silt and refuse had a definite effect in causing ignition.

Methods used to extinguish fires were: (1) water; (2) excavating the fire; (3) trenching to isolate the area; (4) trenching and covering area with fire clay; and (5) spreading fire and quenching with water. Of the 34 fires, 16 were extinguished and the most successful methods were excavating the fire and trenching to isolate the fire area as shown in the following tabulation:

Method	Number of Fires Successful	Not Successful	Total
Water	2	5	7
Excavating fire	7	3	10
Trenching to isolate area	5	2	7
Trenching and covering fire area with clay	2	1	3
Spreading fire and quenching	0	2	2
No Record	0	5	5
Total	16	18	34

There were a number of fire causes; but spontaneous combustion does not seem to be the greatest hazard as outside causes such as trespassers' fires and hot boiler ashes were major contributory factors. It would seem that, although there is no sure method of preventing fires, certain practices should be followed such as (1) enforce "no trespassing" on waste banks; (2) deposit no combustible material on the bank; (3) establish systematic patrol that will discover fire in early stage.

Power and Haulage

Use of A-C Power Underground

By J. O. CREE
Electrical Engineer
West Virginia Engineering Co.

THE use of a-c power for coal mining equipment is not something new. Records show that as early as 1905 a 230-v, a-c hoist for rope haulage was installed in Oklahoma. Later, about 1912, a-c motors were used on some cutting machines and in the early 1920's, a number of scraper loaders and conveyors for coal mining service were a-c powered. At the present time, a few loaders, cutters and face conveyors are operated with ac, but this use is not very widespread in the United States.

The growth of mechanization is centering attention on the advantages of alternating current, especially in concentrated mining where high tonnages are produced from small areas and where large quantities of equipment are centralizing the power demands. For example, a conveyor mining panel in low coal, with six working faces producing from 225-300 tons per shift would have a power demand of about 175 kw. A mobile loader panel in a thick seam, with mining machines and shuttle cars discharging onto a belt conveyor would require about 175 kw to produce 400-500 tons per shift.

For each of these two typical panels, the paper submits drawings showing the complete a-c transmission system for operating all equipment in the panel including conductors, transformers, capacitors, circuit breakers, etc. Charts are presented to show that, at 100 percent power factor, 440-v, a-c power could be transmitted a distance of 2000 ft from the transformer station with a 10 percent voltage loss; for 220 v this distance would be only 500 ft. The charts show how voltage losses are increased and maximum transmission distances reduced by lower power factors ranging down to 60 percent.

Power factor is defined as *"The ratio of actual power used to the apparent power used,"* and a practical explanation is given of the relations between actual power, apparent power and reactive power. Failure to realize the importance of having a high power factor has been responsible for difficulties that have been encountered in some a-c operations.

Comparison of A-C Versus D-C for Mining Service

By DAVID STOETZER, JR.
Mining Division
General Electric Co.

A STUDY of the characteristics of a-c systems shows many advantages over dc for mining service, although there are certain limiting features. The a-c substation consists of a simple transformer bank with minimum switching and connection facilities; it is efficient, inexpensive and light in weight for easy moving. Cost savings in transmission equipment are possible where the substations can be brought relatively close to the load—300-600 ft—but, if ac has to be transmitted over relatively long distances at 440 v or less, extra large cables must be used to keep the line drop within acceptable limits. However, improved line materials and improved techniques will undoubtedly be developed so that a portable substation can be located close to the working panel while still maintaining high factors of safety.

The d-c motor seems to be inherently more rugged and substantial for mining service, and it appears more difficult to maintain the windings in the a-c stator than it is in the d-c armature or fields. Variable speed features add to the complication of a-c motor construction, although recent trends in the design of mining equipment indicate an increasing use of constant speed motors.

A look into the future indicates an increasing use of a-c power for mining service, but an all a-c mine will essentially be without track haulage. Battery locomotives or shuttle cars may be used as auxiliaries, but it is almost certain that conveyors will be the backbone of the transportation system. Cutters, loaders and continuous mining machines powered by ac will all work into the picture. High voltage cables will have to be carried almost up to the room necks. This will involve some difficulty and expense in meeting present safety rules, but should not prove an insurmountable obstacle.

In a mine already equipped and operating d-c power for track haulage, cutting, loading, etc., there seems little possibility of utilizing ac economically. In a new property, designed for conveyor haulage and continuous mining, complete a-c power has excellent possibilities.

Power Controls for Belt Conveyors

By GEORGE T. ATKINS
Electrical Engineer
Barnes & Tucker Co.
and
W. F. ROBERTS
Electrical Engineer
Jeffrey Manufacturing Co.

CONVEYOR transportation has developed from the comparatively simple face and room installations of some years ago to the present day complicated combinations of room, gathering and main line units. As additional tandem and cross belts were added to cover more and more territory, new control problems were presented. For economic reasons it was impracticable to station an operator at each conveyor to see that it started and stopped at the proper time; consequently, an arrangement of interlocked sequence

control was necessary so that the complete system could be started or stopped from one or more locations. As experience broadened, many original control schemes were discarded or improved, and we now have remote control, belt slippage protection, emergency stopping and starting, coal spillage protection and speed variations.

Emergency control for protection of men and equipment must be provided so that the conveyor can be stopped at any point along the line and it must also be designed so that a slate fall on the belt will stop the conveyor. A further safety requirement is to prevent men from being carried beyond the transfer points; a danger light is usually effective but provision must be made to stop a belt in case a man should fall asleep. A paddle arrangement, or a photo-electric cell, is effective but these must be disconnected when transporting coal, otherwise a large lump will stop the conveyor.

Two-speed control is essential in an installation where men and material are transported—a slow rate for man-trips and a fast rate for coal haulage. Many states limit the man-trip to 200-250 fpm while the usual coal carrying speed is twice that. Then, in shuttle-car loading where no transfer device is used, it is sometimes desirable to speed up the belt temporarily so that a shuttle may be emptied in as short a time as possible.

Room conveyor control at the face should be installed where a room conveyor transports from the face to the entry. This allows the face crew to stop and start the unit in emergencies and also saves them from the necessity of going to the starter box that is usually on the entry. The emergency-type pull cord and explosive tested start-and-stop switch can be used, and an explosion-proof telephone with a telecode relay has been operated successfully.

Interlocked sequence control is essential where one or more conveyors are in a system and should be designed to conform to the following requirements: (1) it must be possible to start or stop the system of conveyors from one or more locations; (2) when the conveyor at the discharge station is started, all others of the system must start in sequence in such a manner that no unit can run before the conveyor on which it discharges is running; (3) it should be possible to stop any conveyor in the system, and if desired, run it in reverse independent of the other conveyors; all conveyors discharging on the stopped or reversed conveyor must also stop; (4) when a conveyor is reversed it should automatically be taken out of sequence.

For all of the controls necessary to serve the purposes outlined in the foregoing there have been many home-made devices built at the mines, but manufactured products are now on the market to supply these and all other needs for safe and efficient belt operation.

Modern Mine Haulage with Belts

By C. W. THOMPSON
Manager
National Mines Corp.

THE National Mines Corp. was faced with the difficult transportation problem at their new mine in northern West Virginia as the cleaning plant was located about two miles from the tipple location where railroad cars and barges were to be loaded. Several studies were made of possible ways for transporting coal over this distance which included: (1) surface track haulage for a distance of four miles, (2) track haulage through a two-mile tunnel to the river, or (3) belt conveyor haulage through this same tunnel. These studies and analyses showed the belt conveyor haulage to be decidedly the most economical. This was to have a length of 10,900 ft and an ultimate capacity of 350 tph which required a belt 30 in. wide, operating at a speed range from 300-400 fpm. Several types of belt construction were considered and a compass 150 style belt was selected as being able to do the job, operating in a single length over the two-mile distance without any intermediate transfer points.

The installation is of course a permanent type and is modern in every respect, both as to its construction and operating features. Complete safeguards are provided to protect against every contingency that could be anticipated.

The total cost for operating and for amortization is estimated at $27,420.00 per year, which with an annual estimated tonnage of approximately 1,000,000 tons gives a transportation cost of approximately 5¢ per ton. Compared with the estimates based on the studies of the other haulage systems, as mentioned at the beginning of the report, the total savings to be realized by the use of the two-mile belt conveyor will be over $1,000,000 during the life of the haulage system.

Two important features worth mentioning concerning this two-mile conveyor are safety and continuous operation. From the safety standpoint, this installation should haul 35,000,000 tons of coal without a lost-time accident. The right kind of maintenance should provide continuous operations without breakdowns for the next 35 years at the cheapest per ton mile cost.

Modern Underground Track Haulage

By GEORGE F. LEATHERMAN
Superintendent, Power & Mechanical Dept.
Inland Steel Co.

ABOUT three years ago, Inland Steel Co. increased its holdings by approximately 10,000 acres of coal land adjacent to the Wheelwright mine. For efficient operation of this new territory and combined with the fact that all of the loading underground is now mechanized, it was decided to construct a new modern preparation plant at a point which would be central to all of the present and future mine workings. The site selected is at Price, Ky., and to reach this location it was necessary to construct a 4½-mile haulage tunnel through the property.

Consideration was given to both track and belt haulage, but rail transportation was believed to be best suited to the conditions here. Accordingly, a modern installation has been made with 80-lb rail laid on creosoted ties. Double track was considered but it was felt that single track with five passing sidings would furnish efficient transportation without delays to the trips. The new main line haulage is 4½ miles long and it extends from an assembly yard underground to the Price portal. All coal from the working sections is brought to the assembly yard where it is made up into trips. Calculations indicated that with five locomotives in operation there would be one trip leaving the assembly yard or the tipple about every 16 minutes. Therefore, since the traveling time one way is approximately 30 minutes, a trip should never have to pass more than three trips coming from the opposite direction.

The installation is modern throughout in its trip controls, block signals, etc. Provision is made for safeguarding against all possible hazards as, for example, a simultaneous contact with the trip signals by two locomotives coming in opposite directions; any power failure to the system, including burnt-out globes; possible run-away trips on grades. The track switching is by automatic electric control operated by the approaching locomotive. A further safeguard is provided through constant communication between motormen and trip dispatchers by having each haulage locomotive equipped with trolley-phones. In addition, a permanent mine telephone system is installed at each passing track.

Maintenance of Mining Equipment

By GEORGE L. JUDY
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THIS paper was published in full in the April issue of MINING CONGRESS JOURNAL.

Time Studies

Time Studies to Raise Efficiency

By JOHN K. BERRY
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THIS paper was published in full in the April issue of MINING CONGRESS JOURNAL.

Mechanical Loading Results Via Time Studies

By P. R. PAULICK
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Library, Pa.

THE manager of a modern mine must utilize every form of knowledge at his command and one of the best ways of obtaining and utilizing such knowledge is by the systematic use of time studies. These studies, together with job analyses, have been for years a number-one tool for management in many manufacturing industries, and the same system and methods can be applied generally to coal mining. To show by example what can be done, time studies on three operations are presented in the paper, designated as "A," "B" and "C" each covering the operation of a tractor loader served by shuttle cars. To give a more or less uniform comparison, the natural mining conditions are similar in these three operations, and all used some form of the room and pillar system.

The figures show a wide variation in the performance efficiency—mine A produces 33 tons per man day, mine B produces 46 and mine C produces 20 tons. The time study data on mines B and C indicates why there is such a discrepancy in the two performances. For example, in mine B the productive working time is 91 percent of the shift, while in mine C this was only 74 percent. Mine B loaded 17 places, while mine C loaded only 9, which is partially explained by the fact that the tramming distance for the shuttle car at mine B was 130 ft as compared to 355 ft at mine C. A situation of this kind is of course immediately susceptible to correction.

Continuing the comparison further, the delays at mine C amounted to 26.2 percent of the shift which was at least 16 percent too high. Then on a proportionate basis, mine C lost 168 tons, or in other words, if the inefficiencies as clearly shown by the time study were corrected, mine C would produce at a rate of 37 tons per man day. Such an increase in labor and machine productivity would have an appreciable effect on the over-all mine cost, and since this saving is shown to be practicable and possible through efficient management, the value of a time study and job analysis should be apparent to everyone.

Results of Time Studies in Improving Service Haulage

By PROF. A. W. ASMAN
Chief, Division of Mining
Pennsylvania State College

SERVICE haulage studies are of most value when the mechanical loader is observed at the same time as, in this way, all haulage delays that affect the loading performance can be determined. Unless machine efficiency is involved, it is apparent that delays that do not retard production are immaterial.

Track haulage accounts for the movement of more coal from the face than any other means and time studies have shown a number of critical factors that result in failure to keep an empty mine car under the loading boom. These are: (1) mechanical breakdown of the motor; (2) equipment derailments; (3) conflict with other equipment; (4) shortage of mine cars and (5) operational deficiencies.

Rubber-tired service haulage systems probably have been studied more than any other type, and with all their advantages, they introduce a number of variables which were found by time studies to hinder loading. These are: (1) mechanical breakdown of the shuttle car; (2) delays at the discharge station; (3) faulty section lay-out; and (4) operational deficiencies.

Conveyors of various designs are used as service haulage for hand loading, mobile loading and self-loading arrangements. Although accurate observation on all the operations in a conveyor unit is somewhat difficult, time studies have shown that conveyor haulage yields excellent results if the following factors are properly controlled: (1) preparation of the face for loading; (2) mechanical maintenance of equipment; (3) efficient handling of extensions and moves; (4) elimination of delays at the discharge station, and (5) improving the general sectional operations.

The type of service haulage time study that does most to improve the operating efficiency is one that gets basic data. A combined study—that is, observing two or more operations at the same time—gives the most reliable results as this permits accurate correlation and reveals where improvements can be made in the working cycle.

Strip Mining

Measurable Advantages of Outside Curves in Overcast Stripping

By LAFE STEWART
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The Maumee Collieries Co.
and
R. M. DICKEY
Sales Engineer
Bucyrus-Erie Co.

THE basic advantage for employing outside curves in open-pit layouts is that for any central angle of a circle, the sides of which intersect both the stripping cut and spoil area, if the stripping cut is located closer to the center of the circle than the spoil area, then the distance along the arc of the stripping cut is less than that along the arc of the adjacent spoil area. This is known as an outside curve; for an inside curve the positions are reversed. In the outside curve method, obviously more spoil room is provided than in a straight cut and considerably more than when working on an inside curve.

Outside curves properly developed are seldom arrived at by chance and good fortune, and in following a crop line, a tortuous layout results in an unhappy combination of inside and outside curves. The initiation and continuation of outside curves involve feathering cuts, narrowing and widening of the pit which require planning and forethought, suitable machine maneuvering and a thorough knowledge of the property. However, the advantages of outside curves in deep stripping are sufficiently valuable to warrant the effort required to develop them.

The formula for this study may be expressed as: $S=R\theta$; where S is the length of the arc, R is the radius of the

circle and θ the constant central angle. Applying this formula to a given sector (shown by a sketch) where the radius of the outside curve on the coal rib is 500 ft and the arc of the coal rib curve is 100 ft, then the length of the arc through the center of gravity of the stripping cut would be 90.12 ft, and that of the spoil pile area would be 118.69 ft. In this case, the arc of the spoil pile is 31.7 percent greater than the arc of the coal rib. In another pit where a bench cut is taken this increase in area of the outside curve would be 41.9 percent.

Three charts are submitted; the first two show the percent gain in spoil volume for various radii of curvatures and varying distances between the centers of gravity of the stripping cut and the spoil areas. The third chart shows the percentages of spoil area gained on outside curves and lost on inside curves for different radii.

Wheel Excavator For Overburden Removal

By JOHN J. HUEY
Chief Electrical Engineer
United Electric Coal Cos.

EXCAVATING machines employing a conveyor belt together with a bucket line dredge or a wheel digging tool have been used in Germany for many years and have been largely employed in uncovering a thick vein of material much like lignite under overburden depths up to 250-300 ft. In the U.S., starting in 1943, the United Electric Coal Cos. independently developed two considerably different wheel excavators for application to tandem operations in the Illinois strip fields. One of these, operating near Cuba, Ill., is handling overburden of about 80 ft deep with approximately the top 40 percent being removed by the wheel excavator. This wheel makes a bench cut along the high wall discharging to a short conveyor belt, which in turn discharges onto a long conveyor that takes the material directly to the spoil bank.

The Cuba machine has an over-all maximum length of approximately 318 ft with a 70-ft digging ladder on the wheel, a 32-ft crowd-retract motion, a digging reach up to 118 feet from the center line, and a spoiling reach of 200 ft from the center line. It is able to dig from approximately 25 ft above the coal to about 70 ft maximum height and in some cases, where it is necessary to dig as much as 80-85 ft, an undercut near the top of the bank will let the top 10-15 ft of material fall on to the wheel.

During the years that this has been in operation, a number of mechanical changes have been made from the original design, all of which have helped to increase yardage performance and reduce maintenance costs. The total annual quantity of material handled has increased from 943,000 cu yd in 1945 to nearly 5,000,000 cu yd in 1948, and the average production rate has raised from 537 cu yd per hour in 1945, to 1351 cu yd in 1949.

It should be emphasized that the wheel excavator is a special tool probably limited to a particular type of geological condition and it is doubtful that it will ever be satisfactory for any rocky strata. However, under proper conditions it certainly has great possibility for economical and efficient removal of overburden.

Vibrations From Heavy Overburden Blasting

By L. DON LEET
Seismologist in Charge
Harvard University Seismograph Station

MR. LEET'S paper appears in full on page 56 of this issue.

Radio Communication in Strip Mines

By LEWIS BARCO
Assistant Superintendent
United Electric Coal Cos.

AFTER trying other types of communication, including power line carriers and telephone lines, it was decided that two-way radio was needed at the Fidelity operation. In September 1949, a complete two-way system was installed in 15 mobile units—nine trucks, two shovels, two draglines and two autos of the supervisory personnel.

Almost immediately after the installation was completed we began to get good results in every phase of mining operation from blasting to road building. There is no more waiting for a supervisor to appear at a pit to give instructions; there are no more delays in getting word to the maintenance crew when repairs are needed; there is no more waiting on supplies as such needs are anticipated and the material started on the way to be on hand when required. Any equipment that may be temporarily idle is transferred to another point where it can be used and when a power failure occurs, the whole organization is immediately directed toward discovering the cause and making the repairs. In case of an injury or a fire, help can be summoned at once.

The system transmits on 154.57 megacycles, as licensed by the Federal Communications Commission. It is the first such industrial installation in the area—although several new systems are contemplated near DuQuoin and we are going to install the system at Cuba and Buckheart mines in Fulton County. Every call is heard by all the mobile units and the fixed station, and operating the equipment means simply picking up the microphone, pressing the button and talking. Of course, there are some special phrases used on radio—and a few special phrases not to be used. It took a few of our men a day or two before they understood that the FCC didn't approve of good old-fashioned strip mine language—but they willingly made the sacrifice.

That is the story of our radio system to date. It has become a vital part of our operations, in use every day, and a real aid in strip mining.

Analysis of Power Requirements for Strip Mines

By MAURICE L. QUINN
Chief Electrical Engineer
Sinclair Coal Co.

IN general there are three methods in use for power distribution in strip mining. First is the overhead pole line with one main substation where the incoming voltage is stepped down to the usual 4160 v for distribution. The second method is similar to the first except that high voltage cables are used to distribute the power to the pit. The third method is where the power is purchased at primary transmission such as 33,000 v and the mining company is responsible for the substations necessary to step down the voltage to 4160 v. This system is recommended for the following types of operations:

(1) Crop line stripping where the advance of the shovels from original power source will be increasing at a comparatively high rate
(2) Stripping areas where the coal lies in pockets that are separated by several miles
(3) In pits where the concentration of electrical load is high, as for example when several large shovels or draglines are working in tandem
(4) Where two or more widely separated pits are being mined simultaneously

As the more desirable areas for strip mine operation become depleted and such areas become harder and harder to find, the types of operation mentioned above will be increasing. Areas with higher ratios of overburden to coal, requiring more of the large stripping shovels or draglines, will be worked. This high concentration of electrical load will decrease the economic transmission distance of a 4160 v system. Areas with several separate coal reserves that require two or more pits for adequate production will increase in number and these are contributing factors in the trend toward the purchase of electrical energy at a primary voltage.

The most economical plan of distribution of power for any operation is the one that results in the least amount of money being spent for investment and operating costs from the time the mining operation starts until it is depleted. In order to realize the maximum economy, a substation should be made portable, complete with all equipment. This will eliminate the cost of building a permanent type structure. Overhead pole lines for the secondary distribution can be entirely eliminated by using high voltage cables from the substation to the stripping machine. Although the initial investment is higher, if it is certain that the line will have to be moved at least once, the additional expense will be justified.

Grounding 440-V. Circuits in Open-Pit Mines

By L. E. BRISCOE
Electrical Engineer
Ayrshire Collieries Corp.

IN strip mining there are a number of portable machines operated on 440-v circuits such as drills, pumps, welders, compressors and coal loading shovels. The work performed by the machine subjects them to considerable abuse and as the operating personnel are directly in contact with the equipment, a failure or break in the wiring or cables may result in a serious or fatal injury unless the equipment is protected by some form of grounding.

A direct ground connection from the machine to the earth is not practicable in mobile equipment, particularly where such machine is mounted on rubber tires. Recognizing this situation, the "Open Pit Mining Association—Electrical Division" on September 15, 1947, inaugurated a special study of the many systems proposed for grounding 440-v circuits for strip mining equipment. Protection for the personnel was of course the primary object, but it was recognized that this protection must be practical for application in present open pit operations.

The study resulted in a recommendation of what was termed the "Derived Neutral System." This consists of a grounding transformer for establishing a true neutral on delta-connected transformer secondary circuits, a suitable resistor and relay connected between the true neutral of the ground transformer and the 4 kv neutral and with a metallic connection of fairly low resistance between the motor frame of the portable equipment and the ground connection side of the neutral ground resistor.

Field tests on the system conducted in May 1948 proved conclusively to all members present that the "Derived Neutral System" was satisfactory. The paper, with sketches and illustrations, thoroughly describes the installation methods, pointing out the advantages of the system as demonstrated by tests, but also giving some of the possible faults. The article concludes with the statement that this grounding method as now being installed meets all the safety requirements to a greater degree than any other system yet proposed and definitely fulfills the specifications as set out in the Federal Mine Safety Code.

Use of Voltages Higher Than 4000 For Large Equipment

By J. E. BORLAND
Mining Division
Westinghouse Electric Corp.

IN recent years there have been indications of growing interest in the possible advantages of higher voltage power in strip mines, particularly in those using shovels or draglines of the largest size. The largest machines now have ratings totaling more than 2000 hp in the ac motors driving the M-G sets. This is about three times the horse power formerly used but the present ac power which supplies the larger equipment has remained unchanged at 4000 v. It is noteworthy that 5000 v has long been used in a few open-pit metal mines.

From tests, calculations and experience, the following conclusions may be drawn: With 4000-v power supplied over a pole line and 1000 ft of trailing cable to a shovel or dragline having a peak demand of 2800 kw, the maximum distribution distance that will permit holding voltages at the motors within 90-110 percent of rated motor voltage is about 1.5 miles. With the same conditions of loading and voltage variation and comparable design of distribution circuits, 6900 v will permit a maximum distance approximately 50 percent greater than at 4000 v. At 13,800 v the maximum permissible distance is more than three times that of 4000 v.

For future shovels or draglines, with peak power demand of twice that of the largest machines now in use, power supply at 4000 v would probably be impractical. Accordingly, it appears that 6900 definitely is to be recommended for any shovels or draglines that may be designed in the near future with power demands appreciably greater than those of the largest machines now in use. The higher voltage of 13,800 seems to offer further advantages and may warrant consideration for large equipment; however, such high voltages may introduce certain undesirable complications in the design of the electrical equipment.

Consideration of higher voltages for large shovels or draglines involves also the problem of power supply to other auxiliary equipment, as it hardly would be satisfactory to carry two different circuits into the pit. A possible solution of this problem might be to use a small three-phase transformer in the pit to step down the voltage to a lower value suitable to the smaller motors.

Mine Safety

Anthracite Safety Practices and Progress

By ROGER J. HOWELL
Safety Engineer
Glen Alden Coal Co.

THE recent progress in the improvement of Anthracite safety has been gratifying and it is the sincere hope that the advances gained in recent years can be equalled or improved upon in the years to come. This improvement has been the result of an intensive and cooperative effort covering a wide program of activities.

Education in safety practices is carried on by classes held by the State University, the Pennsylvania Department of Mines, the U. S. Bureau of Mines and the YMCA. All of these have been in cooperation with the mining companies. The United Mine Workers has also embarked on a safety program through the help of the International

Union. Another forward step is a more intensive program of inspection by the company, by the State and Federal Inspectors.

Nearly all Anthracite companies maintain a safety department which, in addition to inspecting working places, make general recommendations for accident prevention and specific recommendations for ventilation, dust and gas control, fire protection as well as supervise first aid and mine rescue training. Special study is given to handling of explosives, protection against shock from electric cables and machinery, and water accumulation underground, a hazard peculiar to the Anthracite region. Considerable ingenuity has been exercised in developing pumping and dewatering techniques to relieve dangerous water heads.

An over-all record for the past ten years for fatal and non-fatal accidents is given in the following table, showing how the accident record has been steadily improved:

	Accidents Per Million Man-hours		Accidents Per Million Tons	
Year	Fatal	Non-Fatal	Fatal	Non-Fatal
1930	1.76	129.10	6.40	469.90
1935	1.78	117.11	5.25	345.29
1940	1.50	128.93	3.57	306.60
1945	1.01	81.12	2.60	211.16
1946	1.14	83.12	2.88	211.55
1947	1.15	82.24	3.06	218.57
1948	0.87	81.24	2.45	216.12
1949	0.80	76.17	2.18	192.83

Safety Practices in Indiana

By RALPH WHITMAN
Superintendent
Ingle Coal Corp.

THIS paper describes safety practices at the Ditney Hill Mine of Ingle Coal Corp. in southern Indiana. The mine is fully mechanized with tractor loading machines and shuttle cars. It is opened by a conveyor slope on a 16 deg angle, approximately 350 ft in length with a 36-in. cord belt.

The coal varies in thickness from 6-10 ft and due to a particularly soft shale above the seam, about 18 in. of top coal is left in as roof support. In addition, systematic and careful timbering is needed. In the rooms, posts are set on 4-ft centers with 6 by 6 in. crossbars as needed. The main haulageways are timbered with 60-90-lb rails supported on steel pins and stringers. At the present time some experiments are being carried on with roof bolting.

All track is laid with 60-lb rail on wooden ties—the rails are welded and have steel gauge rods on the curves and turn-outs. All switches have bridle bars and throws and some electric switch throws are used. The track is kept clean with track cleaners and the main line is sprinkled with water at least once a week. Signal lights, radio phones and telephones are provided at each dispatcher station and each loading unit. All locomotives are equipped with radio phones.

Fresh air is provided by two exhaust fans which give at least 6000 cfm of air at the last crosscut. All air shafts and slopes are steel lined, permanent stoppings and overcasts are of concrete blocks, temporary overcasts are built of 30-in. and 48-in. steel pipes.

Special attention is given to dust abatement. All cutting machines have bug-dusters and calcium chloride is used extensively on shuttle-car haulageroads; this not only lays the dust but makes a firm road. The mine is thoroughly rock dusted kept not further than 80 ft from the working face.

After ten years of operation at this mine, employing the above described practices, we feel that we have attained a certain amount of success. We have produced 6,341,480 tons of coal with only one fatal accident. This is a record of which we are justly proud, but we regard this as an indicator of the ultimately better record which a constant safety program can produce.

Safety Program in Kentucky

By A. D. SISK
Chief
Kentucky Department of Mines & Minerals

KENTUCKY'S safety program began in 1929 when classes to instruct miners in first aid and mine rescue were conducted in Madisonville. Later the Kentucky River Mining Institute was organized at Hazard and its success was such that similar institutes were organized and there are at present seven of these covering all of the principal coal fields of the state. Their purpose is the promotion of safety and efficiency in coal mining and with the cooperation of the State Vocational Educational Department, classes are conducted in practical mining. In 1940 the Kentucky Mining Institute was organized to correlate the safety work and the activities of all district mining institutes. In setting up all of these institutes, and in carrying on their activities, the U. S. Bureau of Mines has been most helpful and have themselves trained a large number of men in first aid, mine rescue and in another important course—accident prevention.

All of these efforts have had beneficial results in promoting safety education and cooperation of the men and companies in observing safety practices. As a result, the State records have shown a continuous improvement in tons mined per fatality as given in the following table.

1930	268,129 tons per fatality
1935	335,329 tons per fatality
1940	379,872 tons per fatality
1945	557,429 tons per fatality
1948	616,249 tons per fatality
1949	1,098,669 tons per fatality

Outstanding safety records of coal companies who mine more than one million tons without having a fatality are recognized by the institutes and the companies are presented with plaques at the annual meetings. Foremen who go one or more years without a lost-time accident occurring to themselves or to men working under their jurisdiction are publicly honored and in most cases are presented with lapel buttons or other trophies.

Safety—The Human Equation

By C. R. STAHL
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MR. STAHL'S paper was published in full in the May issue of MINING CONGRESS JOURNAL.

Bureau of Mines Activities in Preventing Coal Mine Accidents

By J. J. FORBES
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U. S. Bureau of Mines

SINCE the establishment of the Bureau 40 years ago, the coal industry has achieved notable progress in preventing coal mine disasters, although it should not be inferred that the irreducible minimum of fatalities has been reached. During the early days the activities of the Bureau were confined largely to testing explosives and having its personnel assist in recovery work following fires and explosions, but at present the Bureau's activities are on a wider scope. Its work now includes such phases of accident prevention as instruction in first aid and mine rescue, inspection and testing of electrical mine equipment for "permissibility," improved ventilation and air conditioning techniques in coal mine operation, safety education and methods of roof support.

The prevention of accidents from roof falls has always been one of the most difficult safety problems in coal mining, and last year a special Roof Control Section was created in the Bureau. Up to the present, this section has been concerned primarily with roof bolting.

The Bureau has given particular attention to safety education as exemplified by its accident prevention course for mine workmen and officials. At present 22 mining engineers and inspectors are assigned to the various field offices teaching the Bureau's safety course. These instructors are provided with full facilities such as circulars, lantern slides, photographs, diagrams and demonstrating apparatus.

A true measure of the progress in accident prevention is expressed in the following table showing undeniably that efforts to promote safety in coal mining have been effective. As such efforts are continued, the trend of the injury rates will likewise continue downward.

Frequency Rates

	1939		1948		1949	
	Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal
Bituminous	1.36	60.52	1.22	58.28	0.97	55.81
Anthracite	1.71	107.37	.92	81.24	.86	75.18

Administration

Improving Public Relations in the Coal Industry

By A. C. SPURR
President
Monongahela Power Co.

THE coal industry and the electric power industry have much in common—both have been the victims of politics and government interference today is threatening our very existence. As things stand now, we are being used as the stepping stones toward another system which we can spell out as plain socialism.

Why has all this taken place? Largely because we have fallen down on our responsibility of informing the public. We have been too secure in the feeling that we were doing our own job well and that the public recognized this. We have discounted the fact that the government, along with the other influences that figure prominently in our operating problems today, are working harder at public relations than we are.

The coal industry pays the highest wages, housing conditions for the miners are being improved, employes' children have equal educational opportunities as other children and equal recreational facilities. The public has misconceptions about all these things, but how well is the industry telling them the real facts?

Recently the electric power industry has been endeavoring to do the kind of a job the public wants and to tell them the real effects upon their own communities. We have created regional public relations groups for conference and guidance that we may properly appraise what our public and our employes think; we then devise ways and means of properly communicating the correct information to them. I think the coal industry in its various regional organizations has the ideal vehicle for doing the same thing, and I think they should give more thought and time to the public and communicate with those communities whose own prosperity is so closely interwoven with yours.

Another thing is to communicate with your own employes, telling them of the onslaughts that are being made upon your industry and what these onslaughts may mean to them not only as employes, but as citizens.

Training High School and Engineering Graduates for Supervisory Positions in Coal Mining

By H. C. LIVINGSTON
Vice-President, Operations
The Union Pacific Coal Co.

THE Union Pacific Coal Co. has for a number of years been one of the leaders in the coal industry in promoting the training and education of young men for supervisory positions. The program has been on a wide scope, covering high school graduates, college graduates and employes already on the job.

Since few schools offer many courses applicable to mining, with the exception of ground work in mathematics, science and manual arts, these graduates must start their career with the thought of supplementing "on the job training" with regularly scheduled evening classroom work under the direction of qualified engineering and operating personnel. These classes, conducted over a six months' period for three evenings a week, cover primary physics and chemistry, ventilation, hydraulics and applied electricity. General officers instruct in the art of "human engineering."

Engineering graduates are qualified to assume the duties of assistant resident engineer at one of the mining districts, which consists of mining surveys, ventilation surveys, as well as various tests and inspections. If a graduate expresses a wish to enter the operating department, he is usually assigned the position of section foreman or assistant mine foreman.

It has been our experience that although graduates require a relatively short time in which to develop "mining sense," it is necessary that they be completely exposed to all of the many problems of mine operation. General staff meetings are held weekly and it is mandatory that all supervisory personnel attend them from the mine superintendent down to the face bosses, as well as the engineers and the power and mechanical bosses. The staff meeting conforms to an open forum and we find that they do much to encourage "individual thinking" and answering problems of general policy. Selection of potential supervisors is just as important as the training after selection, and regardless of whether the individual is a high school or college graduate, an inventory must be made of his aptitude and qualifications for leadership, previous to his selection as a trainee.

Education to Develop Supervisors For the Coal Mining Industry

By G. R. SPINDLER
Director, School of Mines
West Virginia University

THE rate of increase in the demand for supervisors has exceeded the rate of their development until today there are just not enough capable men for the jobs available. In West Virginia, the 1948 report showed one supervisor for every 14 workers; this was three times the number of supervisors that had been required in 1938.

Vocational training in high schools has been greatly expanded and in West Virginia, as well as in the States of Ohio, Pennsylvania and Kentucky, where specific coal mining courses, limited to the junior and senior years, include such subjects as mine gases, ventilation, explosives and geology. These are designed for boys who have decided definitely to seek employment in the coal mining industry.

In the colleges, the veteran students in engineering courses since the end of the war have included a large number of men with considerable mining experience, but

normally this is not to be expected. The average student of the future will have comparatively little experience in working with or dealing with labor groups. However, it is expected that these men upon graduation will begin their mine employment either in a company-operated training program or at mine labor, but their technical and general education will have equipped them to gain experience rapidly and to qualify early for the first stages of their supervisory work. Company-sponsored programs all have the common objectives of bridging the gap between academic training and operating practices and to take full advantage of the individual capacities of the trainees to permit their advancement as rapidly as their ability warrants.

The problems and responsibilities of supervision in a modern coal mine are such as to warrant and require the best talent available. The specifications for a good supervisor are sufficiently definite as to be adaptable to an organized training program and the practicability and success of such programs have been proved over long periods of time. Public schools, colleges and other public agencies are in position to participate actively in providing important elements of the educational program but it remains for the industry itself to furnish the guidance and incentive necessary to insure the results desired.

Educational Methods to Develop Supervisors From Graduate Engineers and High School Students

By H. L. WALKER

Head, Department of Mining & Metallurgical Engineering

University of Illinois

ONE of the most crucial problems facing the coal industry is the development of its future leaders. These men will be drawn more and more from the professional class and their training is a joint responsibility of the colleges and the industry. The complexities of modern mechanized mining require the employment of increasing numbers of college graduates with technical backgrounds and a broad professional outlook toward management. Some people believe that colleges should train specialists, but this is a serious misconception; actually the best education for future mine executives consists of sound fundamentals. Specialized jobs cannot be learned in college but only through experience.

In developing future leaders, the industry should be in search of men who have intellectual competence, the personality and ability to deal with large groups of people and the desire to learn, lead and get ahead. In line with this thought, the mining engineering curriculum at the University of Illinois contains such courses as economics, labor problems and personnel administration.

The Division of Extension is offering courses for employes now in the mining industry; these are not specifically designed for supervisory training, but it is hoped that the classroom lectures will stimulate a desire for better positions. Then, throughout the State, we are interesting community high schools in offering a one-year course in the science of coal mining for senior students in the hope that such instruction will interest many of these young men to enter the coal industry.

All of the above types of training and education will not bring the desired results unless competent men are selected. It therefore becomes management's responsibility to help in this selection by careful screening, since a high school or college diploma in itself is not evidence of fitness for the particular kind of employment needed in coal mining. Some provision should be made to give the young graduate the orientation needed to progress into a position of managerial responsibility.

Pension Plans

A Future Pattern for Voluntary Pension Plans

By J. W. MYERS

Manager, Insurance & Social Security Department

Standard Oil Co. (N. J.)

ANY discussion of pension plans for company employes must cover a wide range of subjects. Old age is only one of the economic risks against which protection is being sought; the eventual need of a balanced over-all program should be kept in mind when constructing a pension plan and the degree of protection afforded should not be so large and expensive as to preclude possible future need for widows and orphans.

The important consideration in any program of retirement benefits is sound financing—this serves as an automatic brake against the assumption of future liabilities which may ultimately bankrupt the program. A second reason why sound financing is important is that it involves the welfare of the employes themselves. If pension benefits are financed only out of current revenues, an element of uncertainty exists; the pensioner worries about whether he will get his check and the employe worries about whether there will be any money in the pension fund when he reaches retirement age.

A third consideration is that of "vesting," which means giving an employe permanent possession of certain retirement benefit rights. Without such vesting, the employe remains insecure and is likely to seek a high level of governmental benefits. Every effort should be made to maintain the contributory principle, as giving the employe a stake in the cost of the plan sharpens his interest in it. The principle of joint contributions is a further incentive toward sound benefit levels, sound administration and sound financing.

Employers in the coal industry realize the difficulties inherent to a sound solution of the pension problem once a makeshift pattern has been established. Abandonment of the field to the government offers an immediate course of action which is deceptively simple, but the ultimate consequences to the industry, as well as its impact upon the whole economic structure, can easily be imagined. Unless a sound private enterprise approach can be found and taken, the result will be another step toward socialization.

Pension Plan of Johnstown Coal & Coke Company

By C. N. CRICHTON

Secretary-Treasurer

Johnstown Coal & Coke Co.

LATE in 1947 our board of directors authorized a study looking toward the adoption of a pension plan for supervisors, clerical and technical employes who do not participate in the UMW fund. After more than a year's study, our present plan was put into effect, which consists of a definite program of ear-marking or segregating cash to meet present and future pension liabilities.

Our formula results in pensions of approximately $100 per month for the assistant foremen who retire with 20 years' service. Some employes receive less and some more than this amount, but in general we attempted to make the assistant foremen our median. Including Social Se-

curity benefits, we figure that pensions will range from 35 to 70 percent of final earnings, depending, of course, on length of service and average income level.

We adopted the non-contributory plan, but it has a "vesting" provision which gives the employe some equity in the prospective future benefits. Other optional benefits are permitted; should the employe choose, he may elect to receive a reduced pension with the understanding that in event of his death following retirement, his wife or other beneficiary would continue to receive some payment for the duration of their life. Under certain circumstances, with the approval of our retirement committee, early or delayed retirements are permitted. If for any reason the company should suspend or cancel the plan, provisions prevent money already paid in from returning to the company—all funds must be used only for the benefit of eligible employes, retired members or their beneficiaries.

The administration of our plan has been really simple—a corporate trustee invests and handles the funds, and an actuary makes periodic investigations of our data to assure us of a sound basis. Our retirement committee consists of three company executives, and as one of this committee, I have found the work an interesting and rewarding task. Certainly it has given us a new appreciation for some of the old-timers who have been with our company for many years.

Informing Employes Concerning the Problems of Pensions

By ROSCOE C. EDLUND
Plans Board Chairman
Fred Rudge, Inc., New York, N. Y.

EMPLOYERS, employes and the public should have much more information than has been given them heretofore on the problems involved in pensions for old age. There are several fundamentals which are often not taken into account. First is the size and significance of the general problem of pensions in America. Twenty-five years ago there was one person 65 years of age to every 20 of others in the population. Today there is one in every 12 and in another 25 years, there is estimated that there will be one to every six. The proportion therefore of potentially retired persons for whom provision must be made will fall on the younger people to carry and will be constantly growing. A second factor is the idea which is being stimulated by very powerful forces that old people should live not so much by their own savings as on funds supplied by others.

Third, to pay as much as $100 per month pensions, less present social security benefits, to all persons over 65, would take an estimated $12,000,000,000 annually. In the coming generation with the increasing number of old people that figure would rise to something like $20,000,000,000 a year. It is obvious therefore that if we are going on the basis of providing for old age out of someone else's money and if we are to set up reserves to make that purpose come true, we are tackling a burden which is terrific in size and in its implications on many different phases of our economies.

In the light of all this, industrial leadership should undertake immensely more than in the past in the way of disseminating information about the pension problem. We have let government officials and union leaders do this educating in the past and some of it certainly has been in the wrong direction. Information and education on this subject should come from some source and be continuously widespread. Management, I specifically suggest, should start with their own employes and in their own neighborhoods and the issues should be publicized and made completely understandable and clear. If a company hasn't a well-organized, smoothly functioning program of information exchange, then the need for it in connection with the problems of old age pensioning is a good reason for getting such a program set up right now.

Preparation sessions stressed means of production of quality fuel

Wheels of GOVERNMENT

AMC

As Viewed by A. W. DICKINSON of the American Mining Congress

UPSETS in primary elections are causing uneasiness in Congressional circles. The overthrow of Senator Pepper in Florida and the replacement of Senator Chan Gurney in South Dakota by House Republican stalwart Francis Case have brought anxiety to many incumbent legislators. There is a genuine desire to terminate the present session by the end of July and, particularly in the Senate, the leaders are striving toward this objective. In addition to the omnibus appropriations bill, now under Senate Committee consideration, there remains social security expansion and the White House-requested $1.2 billion foreign military aid measure. At the moment the enactment of an excise tax bill is an open question, depending on the speed with which the Ways and Means Committee and the House act and on the nature of the measure which they approve.

Taxation

Both Senate Finance Committee Chairman George and Majority Leader Lucas have expressed doubt that the excise tax reduction measure will be enacted this year, unless the House acts quickly and sends the bill over to the Senate by late June. Ways and Means Committee Chairman Doughton has indicated that a bill will be ready for House floor consideration by June 20.

As discussed in the May JOURNAL the Ways and Means Committee has approved excise tax cuts in excess of $1,000,000,000. To offset in part this loss of revenue the Committee would: (1) require losses from sale of business property to be treated as capital losses instead of as ordinary losses; (2) reduce the interest rate paid by the Government on over-payments of taxes later refunded, from 6 to 2 percent; and (3) tighten dealings in tax-exempt municipal and local bonds. Long-term capital assets would be defined as those held for three months or longer. The Committee has still to act on proposals to increase the corporate tax rate from 38 percent to 40 percent or more. Approval has been given to a one year carry-back and a five year carry-forward of net operating losses.

Administration demands for rate cuts in percentage depletion allowances for oil, gas, sulphur and nonmetallic minerals have been rejected. Fuller's earth, refractory clays, metallurgical limestone, quartzite, perlite, borax, diatomaceous earth and tripoli have been included in the bill to receive percentage depletion at 15 percent; stone (including slate), brick and tile clay, shale, oyster and clamshell deposits, sand and gravel, marble, and granite at 5 percent. The coal rate has been increased from 5 to 10 percent.

Social Security

Senate floor debate has begun on the Social Security bill, H. R. 6000, which was reported by the Finance Committee May 17. Important to the mining industry because of its effect on the independent contractor mine leaser is the bill's definition of "employe."

L. Ebersole Gaines, right, president, West Virginia Coal Association tells Senator Taft imports of foreign oil are gravely threatening the No. 1 industry of West Virginia

The measure defines an "employe" to include: "Any individual who, under the usual common law rules applicable in determining the employer-employe relationship, has the status of an employe."

With this language in the bill, if it remains undisturbed during Senate floor consideration and survives the Senate-House conferees' action, the status of the independent contractor mining lessee (block leasers and split-check leasers) will remain as it is today under current law. The protection of the status of the mine leaser is due to the energetic action of Senators Johnson and Millikin of Colorado, both members of the Finance Committee, and to the excellent testimony presented by AMC witnesses from California, Colorado and Utah.

The Senate bill as reported would add about 8,000,000 employes to social security coverage; the existing 1½ percent payroll tax on employers and employes would be retained until January 1, 1956 when it would increase to 2 percent on each; employe retirement benefits would be about doubled;

Washington Highlights

CONGRESS: Sets July 31 to adjourn.
TAX: Enactment uncertain.
SOCIAL SECURITY: Under Senate debate.
UNEMPLOYMENT: Higher petroleum and metal duties urged.
TRADE AGREEMENTS: Further tariff cuts protested.
INCENTIVE PAYMENTS: New O'Mahoney bill.
ASSESSMENT WORK: Would extend worktime 90 days.
FREIGHT ABSORPTION: Bill in White House.
NLRB: Plan No. 12 rejected.

only the first $3,000 of an employe's annual wage would be taxed; no permanent and total disability insurance would be provided.

Unemployment

No action has been taken by the House Committee on Ways and Means on the proposal to place an import tax of $1.05 per barrel on petroleum to check the unemployment which is seriously affecting the coal industry.

A Senate Labor subcommittee under Chairman Neely of West Virginia has been investigating the causes of unemployment in the coal, oil, silver, zinc, lead and railroad industries. Simultaneously a House Labor subcommittee under Representative Steed of Oklahoma is conducting hearings on the effects of imports on unemployment.

UMWA and industrial witnesses have appeared before both committees presenting data on imports and unemployment and asking that Congress take action to protect American labor and industry.

William I. Powell of the American Mining Congress testified before both the Neely and Steed committees, emphasizing that the excessive and harmful imports of foreign oil have resulted directly in loss of coal markets, closing down of coal mines and a resultant increase in unemployment. He also declared that the record-breaking peacetime flood of lead imports has resulted in 6500 men in the lead industry losing their jobs.

Trade Agreements

At hearings before the Committee for Reciprocity Information representatives of strategic metals and lead and zinc producers vigorously opposed any reductions in duties through foreign trade agreement negotiations scheduled to begin at Torquay, England, on September 28. Norman Hickman, vice-president, American Metal Co., on the other hand, contended for elimination of all duties affecting the importation of zinc ore and slab zinc.

S. H. Williston, vice-president, Cordero Mining Co., San Francisco, demonstrated the sharp decline in the number of strategic metal mines due to foreign competition.

Ernest V. Gent, secretary, American Zinc Institute, declared that the increased volume of zinc imports linked with increased production costs, devalued foreign currencies, and the pressure for American dollars has seriously harmed the domestic industry.

Otto Herres, vice-president, Combined Metals Reduction Co., asserted that the State Department "by cutting tariffs to the vanishing point is squeezing the miner between the low world prices of its free trade foreign policy and the high costs of a subsidized domestic economy." He stated that over 2000 men have lost their jobs in Utah nonferrous mines, mills and smelters and that 1100 miners have been dropped from payrolls in New Mexico.

Felix E. Wormser, vice-president, St. Joseph Lead Co., and secretary of the Emergency Lead Committee declared that domestic output of lead from mine production and scrap, totaling about 400,000 tons each a year, are sufficient to meet U. S. consumption requirements. Wormser stated that if domestic requirements exceed this supply a sufficient volume of lead in ores and concentrates can flow into the United States to make up the deficit, but that pig lead imports are not needed.

The Emergency Lead Committee, headed by J. B. Haffner, vice-president, Bunker Hill and Sullivan Mining and Concentrating Co., has also petitioned the U. S. Tariff Commission for tariff relief under the "escape clause" of the Mexican Trade Agreement. The petition recommends an upward revision of the tariff on lead in ores and concentrates to a level of 2¼¢ (current rate ¾¢), and an upward revision of the tariff on lead in bullion and metal to a level of 3 3/16¢ (current level 1.06¢). The 1930 rates on lead ores (1½¢) and metal (2⅛¢) were cut 50 percent in the Mexican Trade Agreement with the proviso that they should be restored to 1.2¢ per pound on lead in concentrates, and 1.7¢ per pound on metal, 30 days after the termination of the unlimited national emergency. The industry now asks that the lead schedule be revised to compensate both for the adverse effect of competition from countries that have devalued their currencies, and also to adjust lead tariffs to a scale commensurate with the inflation that has taken place in the United States.

Incentive Payments

The reintroduced Engle mine incentive payments bill, H. R. 8221, which will provide a $330,000,000, four-year program and the similar Sabath (Dem., Ill.) measure, H. R. 8668, providing $165,000,000, are pending before the House Committee on Rules. Senator Malone of Nevada has introduced S. 3570, identical with the Engle bill.

On June 6 the Senate Committee on Interior and Insular Affairs authorized Senator O'Mahoney of Wyoming to draft and introduce an incentive payments bill to replace his S.

"Here they are for another short day with top wages"

2105 which was rejected by the House March 16 by a vote of 166 to 144.

Assessment Work

Representative Clair Engle's bill, H. R. 6406, passed the Senate May 31 and is now in the White House where its early approval is anticipated. The measure provides specific means for mining claimholders who performed assessment work during the year ending July 1, 1949 to receive credit for this assessment work for the year ending July 1, 1950.

Also scheduled for early Senate approval is S. 3639 by Senator Cordon (Rep., Ore.), which would extend until October 1, 1950 the time in which mining claimholders may perform assessment work for the current year. The claimholder must file, in the office wherein the location notice or certificate is recorded, on or before noon, July 1, a notice of his desire to hold his mining claim. This extension also presents a good opportunity to do work for the year ending July 1, 1951 at the same time.

A bill recently introduced by Senator Millikin (Rep., Colo.), which would have granted a moratorium on assessment work for the current year, has been rejected by the Senate Committee on Interior and Insular Affairs.

Freight Absorption

Now awaiting White House action is the O'Mahoney freight absorption bill, S. 1008. The conference version of this measure was approved by the Senate June 2 by a vote of 43 to 27. It provides that producers, acting independently, may sell at identical delivered prices at different points of delivery or may absorb freight costs in good faith to meet competition.

In managing the conference report on the Senate floor, Senator O'Mahoney maintained that the measure will aid small business; in this he was fully supported by Senator Wherry (Rep., Neb.) who declared the legislation to be necessary to end confusion over pricing practices which has been created by Supreme Court decisions.

Plan No. 12

The situation described last month came to a showdown in the Senate on May 11 when the Plan was rejected by a vote of 53 to 30. The plan would have reorganized the NLRB by abolishing the independent status of its General Counsel. The opposition was led by Senator Taft of Ohio, who declared, "The President is attempting to make the NLRB the same kind of crusading agency for labor that it was under the old Wagner Act." He asserted that through this plan the President was seeking to undermine the Taft-Hartley Act.

Southern Iron Ores

(*Continued from page 47*)

sure which causes the particles to be maintained in a semi-suspension so that they move rapidly with respect to one another to produce a boiling effect.

Individual particles thus suspended are surrounded by gas envelopes and excellent gas solid contact can be attained. By proper sequence of operation, heat recuperation can be effected, hence the unit offers attractive possibilities provided it can be applied to a wide range of sizes such as those which would be produced in the crushing and preliminary preparation of Red Mountain ore.

Whether this type of unit can be successfully and economically applied is purely conjectural at this time.

It may prove a happy circumstance, too, that coke oven gas could be made available on Red Mountain. Containing a total of about 60 percent hydrogen and carbon monoxide, it is a satisfactory reducing agent "as is." By using it, the cost and heat loss involved in the reforming of natural gas to make it a suitable reducing gas, or in making producer gas from coal, would be avoided. In the Sloss pilot plant, it was found that coke mixed with the charge in a rotary kiln would not effect reduction but that excellent reduction was attained by using high volatile coal in that manner. The likely explanation is that the kiln itself was acting as a still, to produce the equivalent of coke oven gas.

Another favorable circumstance is that a magnetic concentrating plant presumably could handle different classes of ore or mixtures of them without material modification. With several different types of iron bearing material in the Red Mountain formation, this could be an important advantage, not enjoyed by any of the other beneficiation processes available.

All in all, there is at least a basis for some hope that reduction roasting can in time and by diligent effort be brought into favorable cost aspect.

Agglomeration of Concentrate

Assuming that an economic concentrating process is worked out, there remains one final hurdle. From the nature of all of the ores concerned, it is probable that nearly all concentrate produced will be minus 65 mesh in size and much of it minus 200 mesh. This will have to be reaggregated into material suitable for blast furnace use.

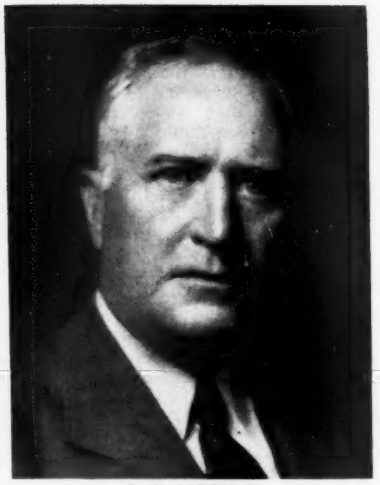
There are four known methods of accomplishing that purpose: (1) Sintering, (2) nodulizing, (3) pelletizing, and (4) briquetting. The Sloss pilot plant experienced no difficulty in nodulizing such material, although the cost was high. The lack of porosity in a bed of such fine material militates against sintering, except as it may be mixed with coarser materials. There have been some instances of successful sintering of fine materials, and further developments can be expected. Nothing is known as yet about the applicability of pelletizing to finely divided artificial magnetite, although large scale tests in pelletizing natural magnetite concentrate are now in progress and may point the way.

Briquetting offers some promise under local conditions. One laboratory claims to have found that finely divided magnetite may be briquetted by pressure alone, without added binder. Portland cement is being successfully used by one producer in the district for briquetting minus quarter inch ore fines. By inference, waste black liquor from sulphate paper mills may be found satisfactory as a binder since it is reasonably effective in briquetting flue dust. This requires baking of the briquets to give them the necessary mechanical strength, but the sensible heat of the calcines coming from the roasting operation might be utilized for that purpose.

Summary

There are substantial tonnages of high silica ore in the Birmingham district which cannot be utilized directly in blast furnaces. Laboratory tests indicate that most of it is amenable to concentration to eliminate the granular silica but not the inherent clay, to yield a product of attractive grade for blast furnace use. Among the standard mineral-dressing processes that are applicable are gravity concentration, froth flotation, direct magnetic concentration, or magnetic concentration after a reducing roast. It is fundamental to the ore constitution that after the required grinding for liberation, the iron mineral will be all minus 100 mesh and most of it will be slime, but the silica should be somewhat coarser. All known concentrating processes, except magnetic concentration after roasting, are thereby faced with the triple handicap of difficult size classification owing to the more finely divided mineral being the heavier, the necessity for accepting hematite slimes as final concentrate without further beneficiation, and the resultant concentrate requiring prohibitively large areas of thickeners and filters for dewatering. A magnetizing roast avoids these handicaps to a degree sufficient for that process to be distinctly preferable from the purely metallurgical viewpoint, but it will entail a higher operating cost than any of the others. Recent developments in fluidized bed roasting, the availability of coke oven gas in the Birmingham area, and the several economies in blast furnace operation made possible by the higher grade magnetic concentrate afford some hope that the cost may be brought within the required limits.

ROY A. HARDY
Consulting Engineer in Charge
Getchell Mine, Inc.
National Chairman, Program Committee



D. D. MOFFAT
Salt Lake City, Utah
Chairman, Western Division, AMC

M. L. McCORMACK
Mgr., Rock Drill Dept.
Ingersoll-Rand Company
Chairman, Manufacturers Div., AMC

Salt Lake City Program Planned

Able Committee Lays Plans for a Convention and Exposition of Top-Flight Interest to Metal and Nonmetallic Mining Industry, August 28-31

MINING-MINDED men from every mineral producing state will find the program of the 1950 Metal Mining Convention and Exposition full of top-drawer information of surpassing value and interest. The Salt Lake City meeting, sponsored by the Western Division of the American Mining Congress, has been the subject of a great deal of careful thought on the part of an extensive group of mining industry leaders.

On May 25 State Chairmen from the principal mining areas and members of the Salt Lake City committee and staff members of the American Mining Congress met in Salt Lake City with Roy A. Hardy, National Program Committee Chairman, and D. D. Moffat, Chairman of the Western Division. In a day-long meeting they reviewed the many suggestions and selected topics for the program that were considered to be of the greatest interest and value to the industry, and arranged to have them presented and discussed by outstanding leaders in the mining industry and in public affairs.

Subjects selected for the general sessions include labor relations, public lands, stockpiling, tariffs, depletion, effect of foreign aid, exploration and development, taxes and the outlook for the metals. A series of sessions on operating problems are scheduled that will appeal greatly to the man on the job who is responsible for filling daily production quotas and carrying on with the constant job of exploration, development, production and maintenance. Included in this important section of the program will be papers on trackless mechanized hardrock mining, rock drilling, shaft sinking methods and devices, metallurgical advances, open-pit practices, mill liners, safety and health, geochemical prospecting, fluo-solids, and a long list of other topics of special value and interest to operating men.

For the last four days of August the Convention and Exposition will carry on at the Utah State Fair Grounds, where the facilities have been considerably enlarged and improved in recent years.

The system of streamlined advance registration, which worked so well at Spokane to eliminate the time spent in going through this formality, will be employed again. Full details will be announced in the Convention publicity. Hand-lettered badges will be made up and sent to all committee members, exhibitors' representatives, and others returning post-card requests for advance registration.

There is no registration fee of any kind except for representatives of non-exhibiting manufacturers. All those interested in mining and the solution of the industry's problems are urged to participate in this annual forum.

MBD Meeting

On Friday, September 1, the Minerals Beneficiation Division of the American Institute of Mining and Metallurgical Engineers will hold its fall meeting at the Hotel Utah. These sessions will supplement the papers on milling methods and metallurgical advancements presented at the American Mining Congress Convention.

Members of the MBD have been hard at work arranging an excellent program. The traditional Scotch Breakfast will again be featured. Those planning to participate in the MBD program may register either at Salt Lake City or in advance, on payment of a $3 fee to the committee in charge.

Entertainment and Trips

General arrangements for the comfort and enjoyment of Convention visitors are being made by local committees headed by R. D. Bradford, General Arrangements Committee; P. H. Hunt, Trips Committee; Louis Buchman, Publicity Committee; E. H. Snyder, Exposition Committee; F. A. Wardlaw, Jr., Reception Committee; and Mrs. O. N. Friendly, Ladies' Committee.

Accommodations at Salt Lake City

are fully adequate to take care of the huge attendance that is already indicated. Reservations should be made immediately to the Housing Committee, Box 329, Salt Lake City.

Several informative and enjoyable trips are being arranged, including a visit to the Kennecott Pit in Bingham Canyon, the Magna and Arthur mills, the Garfield smelter and the new electrolytic refinery. Plans have been made for a visit to the Geneva Steel plant and for an airplane trip over the Bingham Pit, Tooele, Eureka and Park City.

Splendid entertainment is planned for the four-day meeting to provide relaxation following the hours spent in the Exposition and in the meeting rooms. The traditional Galena Days celebration is scheduled for Monday night with the main street of Bingham, Utah, wide open as it was in the booming days of fifty years ago. Plans call for leaving Tuesday evening open, and Wednesday evening will be given over to a Jamboree at Lagoon, Salt Lake's new and attractive amusement park.

The Annual Banquet on Thursday will round out the busy Convention week. Honored guests will be introduced briefly, but the evening will be of the popular "speechless" variety. The banquet will be held in the attractive Rainbow ballroom where fine food and brilliant entertainment will be features of the top social function of the mining year.

Ladies are welcome to attend all Convention activities and their presence is specially requested as a factor vital to the success of the social events. In addition, a number of delightful daytime events are being scheduled by the ladies' committee.

The Manufacturers Division of the Mining Congress, under the leadership of Chairman M. L. McCormack, is concluding plans for the largest and most complete exposition of mining equipment that has ever been shown.

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Homestake Mining Co.

Texas
E. McL. TITMANN
Southwestern Dept.
American Smelting & Refining Co.

Utah
OTTO HERRES
Combined Metals Reduction Co.

Washington
W. L. ZEIGLER
Pend Oreille Mines & Metals Co.

Tri-State District
HAROLD A. KRUEGER
St. Louis Smelting & Refining Div.
National Lead Co.

Lake Superior District
ALEX D. CHISHOLM
Pickands Mather & Co.

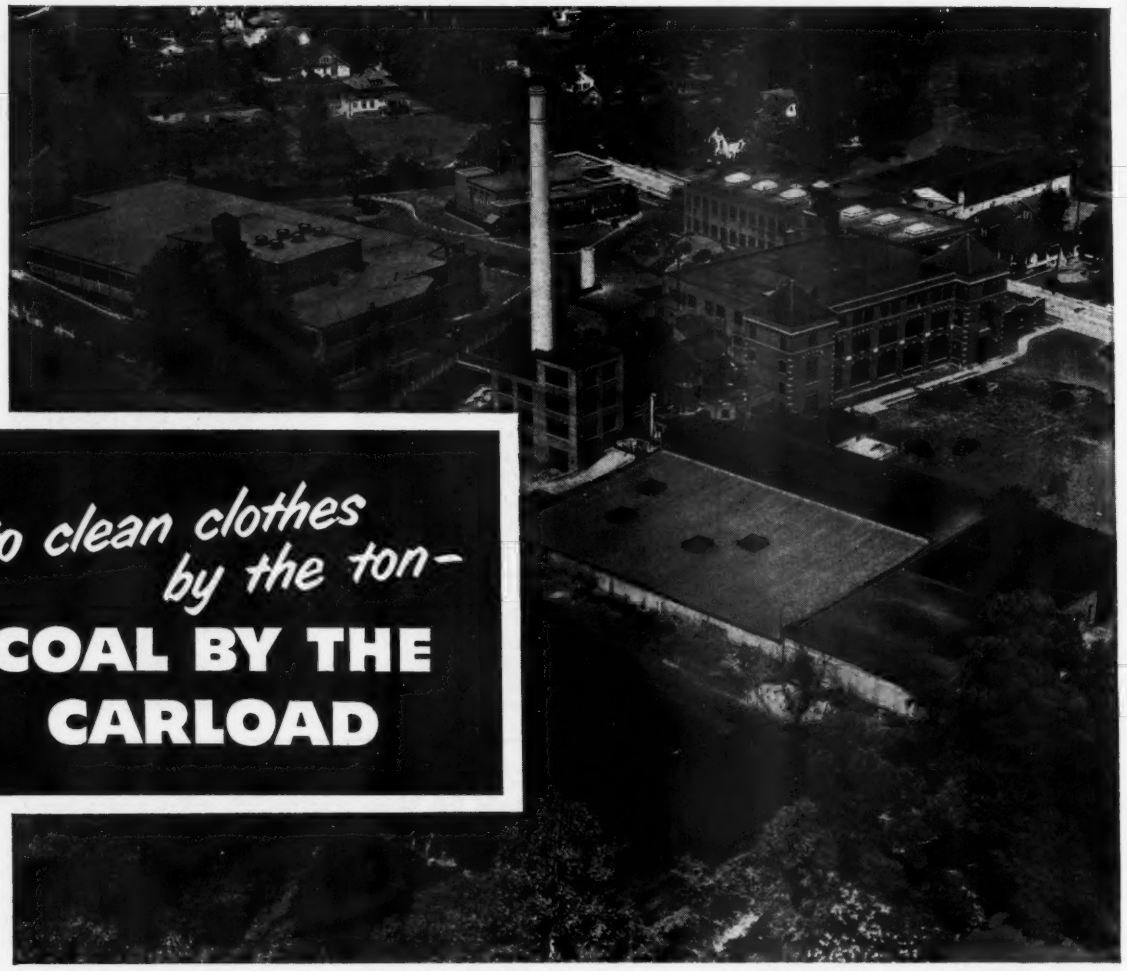
Eastern States
ENDICOTT R. LOVELL
Calumet & Hecla Consolidated
Copper Co.

Manufacturers
M. L. McCORMACK
Ingersoll-Rand Co.

More than 105 manufacturers will occupy 34,500 net square feet of exhibit space, nearly 50 percent more than the record Exposition held in 1948 in San Francisco. The latest developments and improved types of equipment will be on display for mining men to examine and compare. Engineering representatives of the various manufacturers will be on hand to discuss operating problems with mine superintendents, foremen, engineers, mechanical and electrical maintenance men, drill men and all members of mine staffs responsible for production.

An unprecedented wage level adds greater force to the drive for more economical metal and mineral production through mechanized mining. The 1950 Metal Mining Convention and Exposition offers an unparalleled opportunity for operating men to meet and exchange ideas and experiences to solve production problems, and the sessions on matters of general policy will be of exceptional value to mine managers and executives. The many exhibits, together with the informative papers, make attendance a "must" for all mining men who seek new ideas to help them and their companies do a better job.

Meeting of State Chairmen and Utah members of Program Committee. Left to right: Walter M. Horne, Harlan A. Walker, Paul H. Hunt, W. J. O'Connor, Blair Burwell, Cecil A. Fitch, Jr., Nelson Aldrich, James K. Richardson, Sheldon P. Wimpfen, W. H. H. Cranmer, Otto Herres, Julian D. Conover, Roy A. Hardy, D. D. Moffat, Oscar Glaeser, W. C. Page, Burt B. Brewster, H. J. Rahilly, Stuart R. Zimmerley, P. J. Shenon, Stacy Hill, F. A. Wardlaw, Jr., W. L. Zeigler, Joseph Rosenblatt and Wesley P. Goss



to clean clothes by the ton—

COAL BY THE CARLOAD

Plant of the Little Falls Laundry Company, Little Falls, N. J. Photographed by William Vandivert

If your family wash added up to millions of pieces, you'd keep a close watch on the expense of providing hot water and steam. And that's just what the laundry shown above does—because it's one of the biggest laundries in the world.

This laundry uses 50,000 pounds of steam every hour, requires a half-million gallons of hot water every day, and manufactures all the electricity for its machines, dryers, and ironing equipment. It burns coal, of course—more than 150 tons every week—to provide all this heat and energy *at the lowest possible cost.*

To give industrial coal users everywhere a steadily better product, coal operators will continue to invest millions of dollars every year in mine improvements. Older mines are being modernized. New mines are designed to utilize revolutionary new high-production machinery. Washed, graded and treated in huge surface preparation plants, such coal burns with top efficiency. It provides more heat, creates more steam, and furnishes more power per ton.

Because America's progressive bituminous industry continues to pioneer in new mining and coal-preparation methods, coal continues to be America's *foremost* industrial fuel!

Today's most progressive coal mines are like vast modern factories underground, where mechanization has all but banned the pick and shovel. Cutting and loading and transporting are performed by highly efficient, specially designed machines. More and more, today's miner is becoming a skilled machine operator—and his average hourly pay is higher than that of workmen in any other major U. S. industry.

BITUMINOUS COAL

BITUMINOUS COAL INSTITUTE

A DEPARTMENT OF NATIONAL COAL ASSOCIATION

WASHINGTON, D. C.

BITUMINOUS COAL . . . LIGHTS THE WAY . . . FUELS THE FIRES . . . POWERS THE PROGRESS OF AMERICA

AMC Personals

Walter E. Remmers' election as president of the United States Vanadium Corp. was recently announced by W. J. Priestly, chairman of the board. The company has extensive vanadium operations in Colorado and Utah and tungsten operations in California. Mr. Remmers has been engaged in various metallurgical activities of the company since 1936.

A. L. Lynn, vice-president, Island Creek Coal Co., has been elected a director of the Chamber of Commerce of the United States to represent the natural resources division. He succeeds **James D. Francis,** chairman, Island Creek Coal Co., who did not seek reelection.

Walter M. Horne, assistant manager of the Utah Mining Association for the past 18 months, was named acting manager to assume his new duties on May 1. He succeeds **James K. Richardson,** now industrial engineer for the western division of Kennecott Copper Corp., with his office in Salt Lake City.

Walter M. Horne

Sidney Keene, former assistant superintendent at the Illinois state mine rescue station at Du Quoin, is now a state mine inspector.

Harold S. Worcester has been elected to the board of directors of the Golden Cycle Corp., and named assistant general manager. **Max W. Bowen,** vice-president in charge of milling, has been named vice-president and general manager. **Charles H. Carlton** has been appointed mining manager of the corporation and other Carlton mining companies in the Cripple Creek district, and **John Jacobs, Jr.,** has been named comptroller of the company. **Merrill E. Shoup,** president of the company, said these changes have been made primarily as a result of the vacancy created by the recent death of Alfred H. Bebee, for many years vice-president and general manager of the corporation and a number of mines in the Cripple Creek district.

Howard M. Graff was recently named to the post of assistant general superintendent of the Inland Steel Co. In his new capacity he will assist **R. D. Satterley,** general superintendent of iron ore mines.

Stanly A. Easton, president, Bunker Hill and Sullivan Mining and Concentrating Co., is one of four men who will receive honorary doctorate degrees at the University of Idaho commencement exercises in June.

At the April 6 meeting of the board of directors of the Old Ben Coal Corp., **D. W. Buchanan, Jr.,** was elected president of the corporation. The office has been vacant since the death of George F. Campbell last June. All other officers were reelected.

Agatha Keener has been elected a director of Highland-Surprise Consolidated Mining Co. Renamed to the board were **Frank J. Luedke, Henry C. Smith, A. J. Reinhart** and **John Barmettler.**

Ford K. Edwards, formerly an Interstate Commerce Commission official, was recently appointed director of the bureau of coal economics for the National Coal Association.

Dr. Charles Will Wright was recently elected a director of Behre Dolbear & Co.

Vernon G. Leach was recently appointed consulting and research engineer for the Peabody Coal Co. A new department has been established under his direction to consult with larger customers on their problems and to coordinate the preparation of coal by the operating department to meet consumer requirements.

E. G. Coolidge has been appointed executive assistant to **Earl A. Garber,** president of Harbison-Walker Refractories Co.

A. F. Converse, assistant to the president, Bell & Zoller Coal & Mining Co., resigned May 1 to become vice-president of sales for Macweir Coal Corp.

C. L. Holcomb, formerly plant foreman at the Trout Lake washing plant of the Oliver Iron Mining Co., has been named general plant foreman at the Gross-Marble mine washing plant, now under construction. **D. O. Hanson** and **F. G. Steffes** have been named plant foremen at the Trout Lake plant. **W. L. Tomassoni** has been named conveyor foreman at the Fayal mine and **G. A. Kakela** is now pit foreman at the Mountain Iron mine. On the Vermilion range, **G. J. Nemanich, Jr.,** has been appointed lead foreman at the Soudan mine.

Horace B. Holland, executive vice-president and director, C. H. Sprague & Son Co., has been elected president of the Imperial Smokeless Coal Co., Quinwood, W. Va., a wholly owned subsidiary of the Sprague Co. Mr. Holland succeeds **Richard L. Bowditch,** who has been elected chairman of the board of directors.

At a recent board meeting of the Ayrshire Collieries Corp., **James W. Morgan** was elected to the presidency of the corporation and its operating subsidiaries. Since August 1949, he has been vice-president and general manager of the Ayrshire group.

James W. Morgan

The new president succeeds **Robert P. Koenig,** who has resigned as head of the Ayrshire companies after approximately 14 years' affiliation. Mr. Koenig will become president of the Cerro de Paseo Copper Co., but will continue as a director of the Ayrshire board.

Robert P. Koenig

Before joining Ayrshire, Mr. Morgan was associated with the Truax-Traer Coal Co., in charge of West Virginia operations. He has been associated with the coal business since 1921.

Raymond W. Jenkins, former special representative, Joy Mfg. Co., is now assistant manager of Coplay Cement Mfg. Co., Coplay, Pa.

William C. Gordon, for many years engaged in mining engineering and an authority on valuations of mines and properties, has been elected vice-president of a Cleveland firm of management consultants, Industrial Associates, Inc., Cleveland 14. After a varied experience on mine operations and with the Bureau of Internal Revenue, Mr. Gordon in 1944 became an independent consulting engineer, specializing on valuations, depreciation and depletion. He will continue this work in his new connection.

Joseph H. Reid was recently appointed manager of the titanium division of the National Lead Co. to succeed **D. W. Robertson,** former general manager, who continues in a consulting capacity.

George L. Judy, former assistant division maintenance superintendent at the Consolidation Coal Co. (W. Va.), division of Pittsburgh Consolidation Coal Co., Fairmont, W. Va., has been transferred to mine No. 32 as assistant superintendent. **Chester S. Conrad,** maintenance foreman in mine No. 25, has been transferred to the central shop as assistant superintendent.

Dr. Donald H. McLaughlin, president, Homestake Mining Co. and president of the AIME, delivered the commencement address at Montana School of Mines on June 9. At that time, the honorary doctorate of engineering was conferred on Dr. McLaughlin in recognition of his exceptional contribution to the mineral industry.

John V. Beall was recently appointed eastern secretary of the mining branch of the AIME. He will retain his position as editor of *Mining Engineering.*

Carl J. Trauerman of Butte has been named by Gov. John Bonner of Montana as a member of the Columbia Inter-Agency Committee. He is secretary of the Mining Association of Montana.

James Van Evera, chief engineer, Columbia iron mine, Inter-State Iron Co., has been transferred by Jones & Laughlin Steel Corp. to the firm's limestone operations at Martinsburg, W. Va.

A. J. May is in charge of shaft sinking operations for the Utah Construction Co. at the International Minerals and Chemical Co., Carlsbad, N. M.

Henry A. Raymond, former ore sales manager for Cleveland-Cliffs Iron Co., an associate of the company since 1906, relinquished his title on May 1 but retains his association with the company as an ore sales consultant. **W. McK. Green** has been appointed ore sales manager as his successor.

W. Stuart Symington, former Secretary of the Air Force, has been sworn in as chairman of the National Security Resources Board, the agency responsible for preparation of a balanced program for mobilization of all the nation's resources in the event of an emergency.

P. H. Ensign, superintendent of the Magna mill, has been appointed general superintendent of mills for the Utah copper division of the Kennecott Copper Corp. **John Allen,** formerly assistant at the Arthur mill, is now superintendent at Magna. **Thomas Barker, Jr.,** is assistant superintendent at Magna and **F. M. Barton** is assistant superintendent at Arthur.

—*Obituaries*—

Arthur S. Knoizen, 52, executive vice-president and director of the Joy Mfg. Co. died on April 29, at Franklin, Pa. Mr. Knoizen was recognized throughout the mining industry as one of the nation's foremost machinery engineers. Much of the success of the Joy Mfg. Co. is due to his ingenuity and guidance through the years as he came up through the ranks from machinist-welder to foreman, superintendent, salesman and executive capacities to the top. He was a pioneer in the development of the coal loading machine, shuttle cars, the continuous miner and the technique of trackless mechanical mining.

During World War II he served as a dollar-a-year man as director of the mining division of the War Production Board. At the close of the war he was a member of a Government mission to Europe for a study of coal mining problems.

A native of Muskegon, Mich., Mr. Knoizen spent most of the first 16 years of his life in Canada. His first employment by the Joy Mfg. Co. began at Evansville, Ill. in July 1923 when he became associated with J. F. Joy in the new enterprise. He went to Franklin in March 1924 as shop superintendent and was promoted to sales and service manager for Illinois, Indiana and western Kentucky in 1927, becoming sales manager of the firm in 1934. He was elevated to the position of vice-president in charge of sales in 1941 and a few years ago he was elected a director of the company and named executive vice-president.

Mr. Knoizen belonged to a number of industrial organizations. He was a member of the Board of Governors and a former chairman of the Manufacturers Division of the American Mining Congress. Art, as he was known to his many friends, will be sorely missed. He was a real leader and played an important part in developing efficient mechanical mining methods and equipment.

George W. Grove, 63, veteran of more than 35 years' service with the U. S. Bureau of Mines, died June 5, in Pittsburgh, Pa. He was a noted authority on coal-mine safety.

John P. Wilcos, 45, chemical and statistical engineer, Potash Company of America, died recently.

Gordon C. Links, 59, died April 21 in Duluth, Minn. He was once connected with the former Corrigan, McKinney Steel Co., at its iron mining properties at Bessemer, Mich. Later he was employed by Rhude & Fryberger and other mining companies at different times.

Louis H. Allais, 52, vice-president, Columbus Coal Mining Co., Chicago, died on April 21 in Cleveland. His entire business career had been spent with the Columbus Coal Mining Co., which was founded by his father.

Richard James Evans, 52, general superintendent of mills, Combined Metals Reduction Co. died in Tooele, Utah in March.

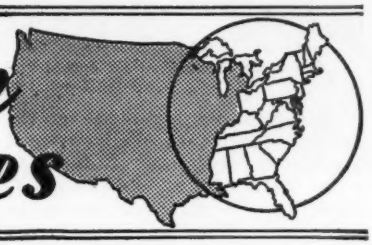
Edward Meiher, 48, coal mine operator of Madisonville, Ky., died March 1 after a grade-crossing accident.

George W. Harris, 74, a prominent industrialist and a founder of the American Potash Co., died in Denver on April 16. He was formerly chairman of the board of directors of the potash company and was also a past president of the Colorado-Utah Fuel Co., which he helped organize. He had organized and served as president of several other coal companies.

Orr R. Hamilton, 68, died April 24 in Duluth, Minn. Since graduation from the Michigan College of Mines in 1906, Mr. Hamilton acquired extensive experience in mining. After two years in the nitrate fields of Chile, and service on the Menominee iron range and in Mexico, he joined the Oliver Iron Mining Co. in 1926, where he remained until his retirement in 1947.

NEWS and VIEWS

Eastern States



Rock Dust Placement

Reporting on a series of tests made recently at the U. S. Bureau of Mines' experimental coal mines at Bruceton, Pa., to determine the efficacy and safety of dispersing rock dust by explosives, the Bureau states that "with proper care, comparatively effective rock-dusting can be done with explosives without the danger of igniting methane or coal dust." Although this method will work, the Bureau does not recommend it but states that application of rock dust by modern spraying machines or by hand is still the safest way.

Comparative results of rock dusting by hand, with permissible explosives and by rock-dusting machines are described in Report of Investigation 4688, available from the publications distribution section, 4800 Forbes St., Pittsburgh, Pa.

ECA Stockpile Purchases

During the first two years of its operations, the Economic Cooperation Administration has commitments for purchases of materials needed for the stockpile, of $54,745,580. Purchases were made by utilizing the U. S. portion of counterpart funds deposited by European countries to match aid furnished under the Marshall Plan.

In addition to purchases of materials, $17,471,000, including the equivalent of $5,376,000 in counterpart funds, was committed by ECA for financing exploratory and development projects aimed at advancing production and the availability of materials required by the United States. The amounts will be repayable in materials produced from the projects.

Commodities purchased included rubber, sisal, bauxite, industrial diamonds, palm oil, graphite, platinum, sperm oil, cryolite, fluorspar, quinidine, tantalite and beryl. Approximately three-fourths of ECA purchases of these materials have already been delivered. Direct purchases with counterpart funds are expected to approximate $23,000,000 in fiscal 1950 and to decline to an estimated $20,000,000 in fiscal 1951. However, it is expected that the decline in purchase activity will be offset by an increase in development projects.

Project contracts have been signed with the United Kingdom, France and Sweden. With the United Kingdom the contracts involve increased production of kyanite and cobalt in Africa and bauxite from Jamaica. Also, general exploratory surveys are now under way in several British overseas territories. The French contract concerns lead-zinc deposits in French Morocco and the contract with Sweden is also concerned with a lead-zinc project.

At the May 3 meeting of the Washington, D. C., section of the AIME, Charles R. Cox, president, Kennecott Copper Corp., was sworn in as a rough-neck, hard-rock miner by Dr. James Boyd, director, U. S. Bureau of Mines. The evening was devoted to the subject of titanium with a talk on the Allard Lake deposits by Mr. Cox, a discussion of the metallurgical problems involved in producing titanium by G. F. A. Stutz, chief of research, New Jersey Zinc Co., and a general talk on the light weight metal by Oliver Ralston, chief metallurgist, U. S. Bureau of Mines.

What do you *think of* WATER?

Abdul Aboo, Bedouin Sheik, states "Water is wonderfull! It keeps the sheltering palms green, my dates in order, and suits my Camels to a T. After a long hard day on the desert, there's nothing like a tall, cool glass of water, the wetter, the better."

Don Al Louis, Coal Dealer, disagrees. He says "Water clings to coal, causes it to clog up chutes and often freezes in transit. It's the Public Enemy No. 1 of the coal industry."

MORAL

There's a place for everything — *And* if you don't like Wet Coal, there's a place for the

C·M·I *Centrifugal* DRYER

in your Coal processing plant

CENTRIFUGAL & MECHANICAL INDUSTRIES, INC.

146 President St., St. Louis 18, Mo.

Coal Mine Foremen Honored

Mine foremen honored for exceptional records of no loss-time accidents gather at the Capitol for a sightseeing tour

Some three score foremen of the Nation's bituminous coal mines visited Washington May 12 and 13, as guests of the National Coal Association, which honored them as leaders in safety work. These men, a portion of the nearly 1000 who are receiving NCA certificates of safety, were chosen by their company for the trip.

On the morning of May 12 they had an opportunity to visit Federal government officials from their home states. At noon they were guests during a safety award luncheon with John D. Battle, executive vice-president, NCA, as toastmaster. On this occasion, certificates of safety were presented to the foremen by Earl R. Maize, director, safety division, NCA. The principal address, "Behind the Scenes in Washington," was delivered by Albert L. Warner, Washington radio news commentator.

During the afternoon a visit was made to Capitol Hill and on Saturday the group took a sight-seeing trip to near-by points of interest.

Veterans Study Mining

The results of a recent Veterans Administration survey disclosed that college enrollment in mining engineering courses, for veterans studying under the GI Bill, had fallen to 1144 in 1949. Veterans taking on-the-job training in mining totalled 133 in 1949. The 1949 total includes 53 mining machine operators.

Mineral Producers Meet

On June 2, the Mineral Producers Association met at the William Penn Hotel in Pittsburgh, Pa., to hold its annual meeting. In the afternoon session, Walter F. Schulten, Pittsburgh Consolidation Coal Co., spoke on proposed national legislation affecting the coal industry. Recent researches on acid mine drainage was the subject of a talk by S. A. Braley, senior fellow of the Mellon Institute. Merritt J. Harding, regional forester, Pennsylvania Department of Forests and Waters, spoke on the extent and character of lands disturbed by open-pit mining and methods of treating the problem.

At the dinner meeting, R. L. Ireland, vice-president M. A. Hanna Co., and president of the Ohio Coal Association, spoke on "Coal Is My Business."

Officers of the Mineral Producers Association are R. R. Bowie, president; R. S. Walker, vice-president; and R. T. Laing, secretary and treasurer.

Joseph A. Holmes Awards

In recognition of individual deeds of heroism in saving life in mines and plants of the mineral industries in 1949, the Joseph A. Holmes Safety Association has approved five medals of honor. The Association also approved 277 certificates of honor in recognition of outstanding contributions to safety in the mineral industries. The awards were selected from more than 500 recommendations received during the year.

Certificates of honor were also awarded to Richard Maize, secretary, Pennsylvania Department of Mines, and to Joseph J. Walsh, deputy secretary of the Pennsylvania Department of Mines for anthracite. It was noted that, under Mr. Maize's leadership, the fatality and accident rates in the Pennsylvania coal mines were reduced from 1.19 per million man-hours in 1940 to .56 for 1949 in bituminous mines, and from 1.50 in 1940 to .85 for 1949 in anthracite mines.

ECA Mineral Experts Sought

So far, 11 U. S. and Canadian technicians have accepted positions under the mineral survey program of the Economic Cooperation Administration. Burton E. Ashley, Floyd M. Ayers and John R. Welch are already in Africa. Soon to leave are Robert R. Reynolds, Allan P. Fawley, Roderick Murchison, Dan K. Hamilton, William Eberth, C. E. B. Conybeare, Walter Lewiecki, and Fred R. Waldron.

About 60 American experts are being sought to stimulate mining programs in British colony. Those interested should apply to the Foreign Geology Branch of the U. S. Geological Survey which is aiding the ECA in staffing the project.

Pleasant View Mine in Production

Full-scale operations were reported in the first week of May by the West Kentucky Coal Co. at its new Pleasant View mine, near Madisonville, Ky. On two-shift operation, the new mine produces approximately 7500 tons per day. The preparation plant has a capacity of 500 tons per hour.

An unusual feature of the mine is a double-deck, steel-lined slope with the top deck carrying a conveyor belt and walkway and the supply track located on the lower deck.

The slope was begun in the summer of 1948 and driven 575 ft into the No. 11 seam, 120 ft below the surface.

A central one-man control system loads washed coal into railroad cars for automatic weighing and transport to market.

Engineer Employment Outlook

A report by the United States Department of Labor forecasts 47,000 engineering graduates in 1950 as compared with 44,000 in 1949 and an average of 10,000 in the prewar decade. Further, the report anticipates a decline in 1951 to 36,000 and in 1952 to 29,000. It appears that this year's graduates will have a difficult time in finding employment as not more than 21,000 jobs appear to be open.

The Department of Labor estimates a median salary of $247 for those who do get a position in the mining and metallurgical field. By the third year the median salary is expected to rise to $272. Mining and metallurgical engineering, with about 5500 undergraduates enrolled in 1950, is not as badly crowded as the other engineering fields.

Strip Mine Opens

The Hallett Coal Co., Barnesville, Ohio, recently opened its No. 1 mine with a daily capacity of 700 tons. Operations are in the Pittsburgh No. 8 seam and the life expectancy is ten years.

CUT HAULAGE COST

...per YEAR

...per MILE

...per TON!

When EDISON Nickel-Iron-Alkaline Storage Batteries power your mine haulage equipment, they help you cut haulage cost in several ways. Their unequalled dependability gives the closest approach to failure-free, uninterrupted haulage it is possible to obtain. That's because their all-steel cell construction withstands rough usage; their alkaline electrolyte is a preservative of steel; their electrochemical principle of operation is free from self-destructive reactions.

They do not require critical adjustment of charge rates—can often be charged direct from the d-c power supply. They can be fully recharged in six to seven hours, which helps get all charging done during off-peak periods.

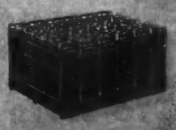
Get a current EDISON price quotation—you will probably find initial cost *much lower* than you think. Couple this factor with well-known EDISON long life and you will have the key to year-after-year economy.

ADVANTAGES OF EDISON NICKEL-IRON-ALKALINE BATTERIES: They're mechanically durable; electrically foolproof; quickly and easily charged; simple to maintain; not injured by standing idle.

EDISON

Nickel · Iron · Alkaline

STORAGE BATTERIES



EDISON STORAGE BATTERY DIVISION

of Thomas A. Edison, Incorporated, West Orange, N. J.

In Canada: International Equipment Co., Ltd., Montreal and Toronto

POWER FEEDS FOR *Thor* DRIFTERS

SENSITIVE CONTROL...

√ Fast feeds, slow feeds (as slow as 2 inches per minute!) rapid return and advance, all controlled from one infinitely variable throttle for top performance under all conditions.

√ Carbide bit breakage virtually eliminated . . . even inexperienced drill runners can hold bit against bottom at correct feeding pressure.

On the job demonstrations now being arranged! Three sliding cone shell lengths — up to 48"x48" (aluminum). Worth investigating—write or wire for a Thor service engineer today! Independent Pneumatic Tool Co., Aurora, Ill.

Air Feed Legs
Backfill Tampers
Belt Sanders
Bench Grinders
Chipping Hammers
Concrete Surfacers
Clay Diggers
Drills
Grinders
Electric Hammers
Impact Wrenches
Paving Breakers
Pin Driver
Rock Drills
Sanders
Saws
Sump Pumps
Wagon Drills

NEW TOOLS TO SPEED DRIFTING
• Air Bar Feeds
• Sinker Legs
• Pneumatic Columns

Thor PORTABLE POWER TOOLS
ELECTRIC • PNEUMATIC

Old Colony Producer

Near Norton, Va., the Old Colony Coal Co. has begun production from the Blair seam. The mine will be developed to a daily capacity of 1000 tons with an estimated life expectancy of 20 years. Five sizes of coal will be shipped from the preparation plant.

Alabama Safety Record

Iron ore mines in Alabama established the best record in the history of the industry in that State in 1949. Only one life was lost, according to a report from the State department of industrial relations.

Steel Firms Lease Coal Mines

A recent report states that the Youngstown Sheet and Tube Co. and the Steel Co. of Canada have taken a lease on the Ontario coal mine of the Hillman Coal and Coke Co. near Ellsworth, Pa. This mine is said to have a daily capacity of 2500 tons.

Universal Exploration Closes Zinc Operation

On May 15, general superintendent E. P. Jennings of the Universal Exploration Co. closed its mining operation near Talcville, N. Y. The zinc property is a subsidiary of U. S. Steel Corp.

Operations were begun in 1940 after extensive diamond drill work in 1938 and 1939. The developed mine had a capacity of about 90,000 tons of ore per year. In part, the operation was undertaken to meet the abnormally increased demands for zinc preceding and during World War II.

West Kentucky Mine Opened

Early in May the Nashville Coal Co. conducted a formal opening of its new mine which will be operated by a subsidiary, the Miners Coal Co. A brief ceremony was conducted, with Justin Potter, president of the company, presiding. Participating in the program was Milton H. Fies, consulting engineer and manager of coal operations at the Alabama Power Co., for whom the new mine was named.

The Fies mine, now producing 2000 tons per day, will have a capacity of approximately 7500 tons per day when in full operation. With an estimated annual output of 1,800,000 tons, the mine will have a life of about 30 years.

The preparation plant, now near completion at an approximate cost of about $800,000, has a capacity of 500 tons per hour. Underground, the mine is fully mechanized, utilizing mobile equipment and main line rail haulage with 15-ton locomotives and nine-ton drop bottom cars. A 1000-ft belt conveyor on a slope brings the coal 250 ft to the surface.

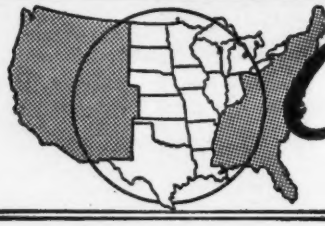
THE fight is on to save more lives in 1950! Now is the time to back science to the hilt in its battle against cancer.

Important gains have already been made. Last year, 67,000 men, women and children were rescued from death by cancer. Many more can be saved—if *you* resolve to save them —if *you* strike back at cancer.

Give! Give your dimes and quarters and dollars. More treatment facilities are needed, more skilled physicians, more medical equipment and laboratories. The success of great research and educational programs depends on your support.

Your contribution to the American Cancer Society supports these vital efforts. It helps guard your neighbor, yourself, your loved ones. So this year, strike back at cancer . . . Give more than before . . . Give as generously as you can.

AMERICAN CANCER SOCIETY



Central States

American Zinc Buys RFC Facilities

Late in April the American Zinc, Lead & Smelting Co. announced that its wholly-owned subsidiary, American Zinc Co. of Illinois, purchased from the RFC all the plant facilities and leases formerly held at Monsanto, Ill., and Fairmont City, Ill., that were installed during World War II. These facilities include installations at the Monsanto Electrolytic Zinc plant and zinc concentrate roasting, sulphuric acid, zinc furnace blocks and by-product facilities located at the Fairmont City plant.

Approximately $500,000 will be expended to cover plant changes that will materially improve the over-all metallurgical and plant efficiency.

Rabbit Lake Stripping

Pickands Mather & Co., representing the Youngstown Mines Co., owners of the lease on the Rabbit Lake iron deposit on the Cuyuna range of Minnesota, is pumping from the Kennedy shaft to dewater the lake bed. This work is preparatory to the start of stripping operations to remove the remaining material overlying the iron ore deposit.

The Union Construction Co. dredge has completed its part of the development plans in two seasons of work in moving lake bed material.

Strip Land Planting

After weather-enforced delays, a program of mass planting of trees is now in full swing on mined-out areas of Indiana. The project to plant 2,003 acres of land in the southwestern section of the state, is a continuation of the program in which the open-cut mine owners of the Indiana Coal Producers Association have planted 26,500,000 trees in over a quarter of a century.

In 1950, 1,362,000 trees will be planted. Of this number 504,000 are native hardwoods and 858,000 are conifers.

High School Coal Mining Course

Du Quoin Township High School, Du Quoin, Ill., will become the first secondary school in Illinois to inaugurate a course in coal mining. The course will begin next fall with full credits awarded and is designed to give young men a general background providing for their safety and more rapid advancement in the industry. Similar courses have been successfully taught in Ohio and Pennsylvania schools.

Charles Swinney, instructor of the new course, will spend the summer at the Union Colliery Co.'s new Kathleen mine to learn modern mining methods.

Taconite Project Starts

On April 4, ground breaking ceremonies were held marking the start of construction by the Oliver Iron Mining Co. of an experimental fine ore and taconite agglomerating plant at Virginia, Minn. It will be a new industry for the iron range with a payroll of over $250,000 a year. "This major experiment," an official states, "is one of the bold and costly steps in a $17,000,000 to $20,000,000 program to secure basic information before building permanent, commercial taconite plants." The program includes five stages: exploration, research, mining, separation and cementing together or agglomeration, of the powder-fine iron minerals.

The new agglomerating plant will be the first sintering and nodulizing pilot plant on the Mesabi range, and will have the capacity to produce approximately 1,000,000 tons of ore per year made into nodules. This plant will experiment with only two methods, nodulizing and sintering, in an effort to select a method to be used in the permanent taconite plant whenever it is built. Three main buildings are to be constructed, the largest a city block long, five stories high, and 60 ft wide. It is expected to be finished by the end of the year.

Homestake Sets New Mark

The Homestake Mining Co., Lead, S. D., has set a new postwar record for production during the first three months of this year by mining 307,854 tons of gold ore valued at $4,610,081, according to the quarterly report filed with the state division of taxation. During the same period in 1949 production was valued at $3,208,699 and during the last quarter of the year it was worth $4,568,221. The value of ore mined represents a gain of $41,860 over the last quarter of 1949. The mine produced 1,112,185 tons of gold and silver ore valued at $15,683,159 during 1949, compared with 1,275,138 tons valued at $17,068,438 during 1942 before the forced shutdown because of the war. Figures show that Homestake production has steadily increased since the resumption of operation following the war and especially since employment has increased. Guy N. Bjorge, general manager, attributes the record for the first three months of the year to two factors—increased employment and greater efficiency of mine personnel. Total Homestake employment at the end of 1949 was about 2050, the largest payroll since the war.

Lake Ore Season Opens Late

The first shiploads of iron ore from the Mesabi Range left Duluth during the last week of April to arrive at Lorain, Ohio, on May 2. The first trainload from the range left Virginia, Minn., for Duluth on April 28. In 1949 the first such train left on March 25. Ice in Lake Superior had delayed the first train this year, tying up ships which carry the ore eastward. The ships left for the lower Lakes with some 22,000 tons of ore in the first shipment. Other vessels were waiting at Duluth to load ore as the lake season got under way for 1950.

Copper Range Reports Progress

At the annual meeting of the Copper Range Co., Morris F. LaCroix, president, told of progress made in working out metallurgical problems in the development of the company's large, low-grade White Pine copper property. A pilot mill is under construction to prove laboratory tests that indicate that a much higher grade of concentrates could be obtained with coarser grinding than that customarily employed.

Mr. LaCroix said the pilot plant should be finished by the latter part of 1950 when the company hopes it will be in a position to put the whole project on the drafting board and make estimates. The company is thinking, he said, in terms of an initial plant with a daily capacity of 3000 tons and the addition of more 3000-ton units as warranted.

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Tri-State Employment Declines

At the termination of the Premium Price Plan, June 30, 1947, there were 5700 employes in the lead and zinc industry in the Tri-State district. By October 1948, employment had been reduced to 3400, largely as the result of shut downs and the mechanization of those operations that continued in production.

Favorable zinc and lead prices during the latter part of 1948 and the first quarter of 1949 boosted employment to an estimated 3900. Following the price collapse in 1949, employment on March 10, 1950, had declined to 2000.

Six small custom mills average less than five days per week of operation at present. The workweek of 30 percent of mining company employes has been reduced to five days. Wages have been reduced from a minimum of $3.08 to as much as $5.00 per day at some operations. More than 1200 people formerly employed in mining were reported to be receiving unemployment compensation early in April.

Mining Scholarships

Prospective students of the Michigan College of Mining and Technology, Houghton, Mich., have available three industrial awards that cover all expenses for complete four-year courses in specified branches of engineering. The Calumet and Hecla Consolidated Copper Co. offers a scholarship in either mining or metallurgical engineering. The Montreal Mining Co. makes a grant for study in mining engineering. The Lake Shore Engineering Co. provides a four-year scholarship in either mechanical or electrical engineering.

Although all three of these industrial scholarships cover the entire expenses of a student's Bachelor of Science course, eligibility is limited to the geographical area in which the individual company operates.

Kennecott Copper Corp provides a one-year scholarship in mining engineering for students who have completed three years of work leading to the Bachelor of Science degree or who have completed that degree and wish to continue graduate work. The Cleveland Cliffs Iron Co. has established an annual graduate fellowship in the mineral dressing field available to students who have completed the work required for the BS degree in mineral dressing or metallurgy.

Minnesota Peat Mining

The Minnesota Resources and Rehabilitation Commission has asked Congress to help develop the use of peat. The commission says Minnesota's vast peat deposits could be used for cheaper fuel in processing ore and producing power.

Minnesota has an estimated 60 percent of the United States deposits of peat. At the Floodwood, Minn., experimental plant, peat is sucked out of bogs and a 26-ton pilot plant at Chisholm is handling 10,000 tons of peat annually.

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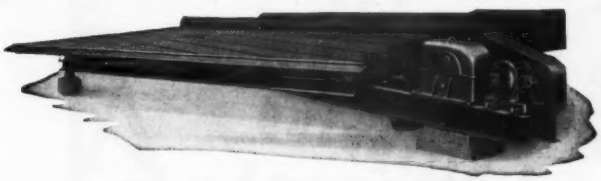

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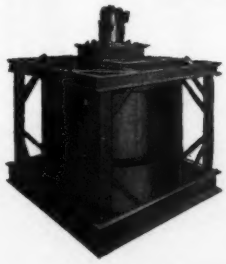

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Federal Holdings

Five drills are in use on land recently purchased from George Potter by the Federal Mining and Smelting Co. Two rigs are on the Pocahontas area.

Iron Ore Reserves

Michigan's 1950 iron ore reserves are estimated at 149,803,000 tons, according to the geological survey division of the State Department of Conservation. This compares with 153,526,000 reserve tons in 1949.

Iron deposits in the Marquette range are estimated at 65,110,000 tons; Iron County, 55,036,000; Gogebic County, 29,099,000; and Dickinson County, 558,000 tons.

Iron Mine Plans Deep Level

The Montreal Mining Co., Montreal, Wis., on the Gogebic iron range is preparing to extend its No. 6 inclined shaft to the 40th level. With a vertical depth of 3786 ft, this new level will be the deepest iron mine in the Lake Superior region. Extraction from the 40th level will be accomplished by hoisting to the 35th or main haulage level for transfer to the main hoisting shaft to take the ore to the surface.

Old Producer Reopens

Near Dadesville, Dade County, Mo., an old zinc silicate mine with a shipping record of thousands of tons of calamine produced from shallow diggings, has again come into prominence, this time as a lead producer. Owner of the property, Kenyon Mining Co., has uncovered an area reported to be of unusually high lead content for the district. The deposit was discovered in the course of stripping operations undertaken in the hope of finding ore.

A shaft was sunk using a clamshell bucket. At this time the shaft is 70 ft deep and has produced many tons of lead ore. The largest single piece removed is said to have weighed 1500 lb.

Sinclair Acquires Southern Coal

Recently the Sinclair Coal Co. announced acquisition of the controlling interest in Southern Coal Co., Inc. Effective May 1, L. Russell Kelce was elected to the presidency of the Southern Corporation. S. L. Jewell will continue as vice-president and director of sales with headquarters in Chicago; P. B. C. Smith was elected vice-president in charge of the Eastern division of the company with headquarters in Knoxville, Tenn.; and B. R. Smith will continue with the eastern division in an advisory capacity. Mr. Kelce was also elected president of a newly-formed and wholly-owned subsidiary of Southern Coal Co., Inc., to be known as the Sinclair-Southern Coal.

Book Reviews

1947 MINERALS YEARBOOK. *By the Bureau of Mines, United States Department of the Interior. Washington, D. C.* $4.25. 1616 pp.

The latest issue of the *Minerals Yearbook*, an authoritative source of information on both domestic and foreign mineral production, is now available for distribution. Bound copies may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Complete and factual information is presented on the peak year of mineral production. The output, distribution and consumption of all known minerals and commodities are recorded. The volume was written and edited by nationally known authorities in the field of mineral economics and technology and compiled and published with the cooperation of the mineral industries of the United States.

Four main divisions are incorporated in the 1947 yearbook: general, commodity, state, and foreign reviews. A comprehensive index facilitates finding specialized information. There are 64 chapters in the volume.

MINING CAMPS. *By Charles Howard Shinn,* 1948. *Alfred A. Knopf, Inc., New York.* $4.00, 291 p.

Originally published in 1885, this study in American frontier government has been republished in conjunction with California's centenary celebration. Mr. Shinn's book is an important account of life in the California mining camps with the accent placed on the laws governing those early entrepreneurs of the mining industry and how those rugged individuals circumscribed their own activity for the common good.

The principles laid down in those early years of American mining have been extended into other regions throughout the western states and constitute an important part of the United States history. The laws the miners made were based upon a distinctive habit of thought and have been reflected throughout this country and much of the world.

UNDERGROUND COAL GASIFICATION IN EUROPE. *By O. Mezzetti. Translation by Accurate Translation Service, Inc., Washington 5, D. C.* $15.00. 12,000 words.

Copies of the typed translation of experimental underground gasification projects conducted in Italy, Russia and Belgium are available including the tables, charts and graphic layouts of the test. Analyses of gases, the type of coal burned and other details are included in the report.

The work done by 28 coal companies, the Brussels University and the Belgian Government in 15 coal beds is covered in a report on the underground gasification of anthracite. Italian experiments were on lignite of high moisture in thick seams with an average pitch of 12 deg. Results of the best tests showed 550 cu ft per ton and gas ranging from 71-133 Btu and with a recovery of 40 lb of tar and 5.44 lb benzene.

Russian investigations near Moscow and in the Don basin with air, air and oxygen and air and steam show gas as high as 280 Btu.

Reference is made to the first Alabama Power Co. experiment and the statement is made that high production in the United States as compared to Europe should not indicate cheaper gas by underground gasification methods.

INDUSTRIAL MINERALS AND ROCKS—2d ed. Completely revised. 1949. *Samuel H. Dolbear, Chairman, Editorial Board, the Committee on Industrial Minerals Volume. American Institute of Mining and Metallurgical Engineers, N. Y. $8.00. 1156 p.*

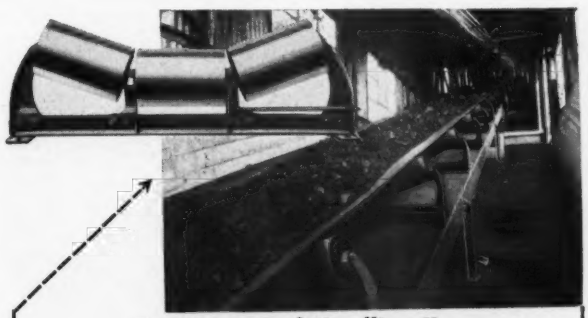
Since publication of the first edition of Industrial Minerals and Rocks in 1937 there has been a growing need for more complete up-to-date information on this important group of mineral products. The second edition takes full account of the many technological advances in the industry and the development of new uses for the nonmetallic minerals. Four new chapters have been added in the new book which has a total of 51 chapters and comprises 200 pages more than the earlier edition. Each chapter is concerned with a single mineral or rock or a group of related ones. Thus the entire field is covered. Those chapters which have been added are: Secondary Fertilizer Minerals, Pyrophyllite, Quartz Crystals and Vermiculite.

Although a number of the original authors have contributed to the new volume, there are also many new authors who have participated in this comprehensive reference book.

Use of the book is simplified by a 45-page index. The subject matter within each chapter is arranged according to composition; properties; origin and mode of occurrence; distribution of deposits; political and commercial aspects; production and consumption; prospecting; exploration and mining; beneficiation; testing and specifications; marketing, utilization; prices; and a bibliography of sources of information. Subheadings provide a further break-down of the detail presented and the bibliographies are especially valuable to those who wish to consider a given subject in greater detail.

Well-qualified specialists are the authors of the many chapters. Their work was contributed without any remuneration. Publication was made possible by an appropriation made by the Seeley W. Mudd Memorial Fund.

Every man concerned with this large group of minerals of growing importance will find Industrial Minerals and Rocks a valuable source book of accurate information.



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Western States

Nevada Manganese Production

Substantial manganese production from Nevada properties is indicated before the end of 1950. American Manganese, Inc. is to start constructing a large capacity plant to process ore from the Three Kids property, northeast of Henderson in the near future, and Combined Metals Reduction Co. has announced it would build a refinery near Henderson for recovery of manganese, lead and zinc from concentrates produced by a plant to be installed at its properties in the Pioche district.

American Manganese acquired the Three Kids property and facilities, formerly operated by Manganese Ores Co., from the State of Nevada last fall for $250,000. At that time, Roy Golener, company vice-president, said construction of a plant using a new metallurgical process would probably start early in 1950. Cost of the projected plant is estimated at $750,000. The U. S. Bureau of Mines has credited the mine with containing 5,000,000 tons of ore assaying 18 to 25 percent manganese. The property was operated on a major scale during the war.

San Manuel Extends Holdings

A United States patent, covering 82 contiguous lode mining claims, has been issued to the San Manuel Copper Corp., a subsidiary of Magma Copper Co. This is said to be the largest number of lode mining claims ever included in a U. S. mineral patent.

The application for patent was made on August 13, 1949, following approval of the survey on August 4. It was issued on April 11, 1950, just eight months after the original application was filed. However, more than four years had been spent in surveying and in preparation for patenting, including extensive field examination and adjudication work. The patent contained more than 100 pages of descriptive matter. The case was handled before the Bureau of Land Management, Department of Interior, by John H. Page and David B. Morgan, land attorneys of Phoenix, whose firm has been engaged for many years in patenting mining claims.

In announcing the granting of patent, Secretary of the Interior Oscar L. Chapman stated that the San Manuel mines are believed to be one of the three largest copper deposits in the country, with reserves estimated at about half a billion tons of ore averaging 0.8 percent copper. The two other largest copper deposits were identified as the Bingham Canyon, Utah, mine of Kennecott Copper Corp. and the Morenci, Ariz., mine of Phelps Dodge Corp. All three mines were developed on lands which were originally part of the public domain.

Clarkdale Smelter Closes

Thirty-four years as a copper smelting center ended on June 6 for Clarkdale, Ariz. The Phelps Dodge Corp. closed the Clarkdale smelter on that date.

C. E. Wells, general superintendent, stated that "due to the depletion of the ore reserves" the termination of operations was necessary. "Concentrating operations," he said, "will continue for a presently undetermined period of time."

Operations at Jerome were not affected immediately, and there was no work reduction in the mines. However, the work force at Clarkdale was cut by about 150 men, some of whom were transferred to other Phelps Dodge operations in the state.

Concentrates from the United Verde Branch will be sent to the reduction works at Douglas.

The cutback at Clarkdale had been expected for some time and there has been much speculation about the disposition of the plant. Company officials said no decision has been reached on whether to dismantle the smelter and move sections to other mining operations or leave it intact temporarily.

Sheridan-Wyoming Plans Ahead

In a recent address Walter Johnson, president, Sheridan-Wyoming Coal Co. stated "we are prepared to spend $1,000,000 to improve the property and the service it can give the public." He was speaking of the Roundup Coal Mining Co.'s property at Roundup, Mont., on which Sheridan-Wyoming took a three-year lease last September, with an option to buy. Mr. Johnson stressed that the company is not at Roundup to "skim the surface and the cream," but plans to "dig in." "If plans work out at Roundup as we hope—and we think they will—we intend to go through with this expansion and improvement program."

Signal Mining Co.

The Signal Mining Co. has started development work on properties recently acquired located at Bannack, Mont., according to Frank Eichelberger, who directed the opening. Frank Taft of Seattle is superintendent.

Best Mines to Operate

Operation of the Brush Creek gold property in the Goodyear's Bar area near Downieville, Calif. on a major scale is slated by Best Mines, Inc. Lewis L. Huelsdonk, general manager, reports a new tunnel is to be driven 2200 ft to develop the vein system at considerable depth. The ore will be trucked to the 100-ton mill at the Oxford mine under lease to Best Mines. Best Mines is also completing the rehabilitation of the Gold Bluff property and is considering resumption of work at the adjacent Oxford.

Utah Halloysite

The Dragon Consolidated Mining Co., subsidiary of North Lily Mining Co., produces Halloysite, a form of clay, from its Eureka District mine in Utah. The clay is shipped to Filtrol Corp., which processes it into catalytic agents for refining.

IMCC Sinks

At Carlsbad, N. M., the International Minerals and Chemical Corp. now has under way a $1,500,000 development program. A three-compartment shaft is being sunk to a depth of 1000 ft by the Utah Construction Co. to tap an extensive new ore body.

San Pedro Resumes Work

The San Pedro mine at Tombstone, Ariz., closed for several months, has been leased by Giacoma Brothers and work resumed. About 200 tons of silver ore are being mined monthly from open stulled stopes and from drifts along the vein. A. P. Giacoma, Box 546, Tombstone, is directing the work, employing a crew of four men.

AS&R Drills in Tonopah

The American Smelting and Refining Co., is conducting a drilling program near Tonopah, Nev., on property belonging to Tonopah Development Co., a subsidiary of Calumet and Hecla Consolidated Copper Co., of Boston and Michigan. The AS&R Co. has made an agreement with Tonopah Development for control of the property, and has an option on the Saunders group of 11 claims which adjoins Tonopah Development ground on the north. Starting about three years ago, nine holes were drilled by Tonopah Development. In its annual report, issued in early 1949, the Calumet & Hecla management reported that mineral indications warranted further exploration. Drilling was begun early in April of this year.

Coal Lands for Lease

The Bureau of Land Management office in Billings, Mont. has announced that coal lands in Sheridan county, Wyo. would be leased on competitive basis with bids to be opened on May 31. Sealed bids are being received for the 240 acres of land located about 15 miles northwest of Sheridan.

Climax to Build A-Ore Mill

The Climax Molybdenum Co. has announced it will construct a mill at Grand Junction, Colo. to process uranium and vanadium ore mined on the western slope. The announcement, made at the annual stockholders meeting in New York, said the mill would have a capacity of 50-100 tons of ore daily. The ore will come largely from mines of the Minerals Engineering Co. of Grand Junction. Agreement has been reached on all major provisions of a contract with the Atomic Energy Commission which controls mining, processing and distribution of uranium. A new corporation probably will be formed to conduct this operation. The Minerals Engineering Co. will receive an interest upon transfer of its mining properties.

Mechanical Mining at Lincoln

The Clayton Coal Co. is rapidly developing its highly mechanized Lincoln mine 30 miles north of Denver. Present tonnage during the development stage is up to 800 tons per day and the working force consists of 40 men. Present production is mined with a Joy Continuous Miner and shuttle cars. The "Miner" takes a 30-in. cut, 18 in. deep in a seam of coal 9 ft thick. Between 18-24 in. of top coal is left to maintain good roof conditions, otherwise exposure of the soft roof rock would create costly roof support measures. No timbering is done or expected to be done until retreat mining begins.

The seam lends itself to ideal conditions for mechanical mining in that it has adequate height, no middle man and coal with a high moisture content. By using a shuttle car as a surge unit behind the miner there is no delay in cutting. Shuttle cars of six-ton capacity transfer the coal to a conveyor belt that discharges on the main slope haulage belts.

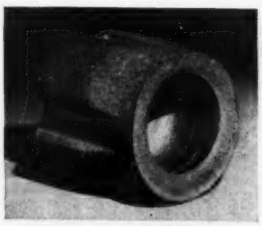
The slope conveyor system is composed of two 900-ft sections on a 15 deg angle. Belts travel at 300 fpm, are five ply and 30 in. wide carrying the coal to an all steel tipple and screening plant erected by the Link-Belt Co. The main slope is supported by ¼-in. Armco plates resting on concrete foundations.

Future plans include the addition of another Joy Continuous Miner and shuttle cars to attain a daily output of 2000 tons.

Nabob Plans Exploration

Plans for thorough exploration of the seven vein structures cut by the main haulage tunnel of the Nabob Silver-Lead Co. have been formulated. Operations of the company are concentrated in the Pine creek area of the Coeur d'Alene district of Idaho.

Included in the development program is an east drift on the middle vein of the three veins in the Denver group with systematic drilling of the vein systems on either side. A west drift will be driven on the first vein cut by the main haulage tunnel. Diamond drilling will explore the three parallel veins of the Nabob and Crystolite system.



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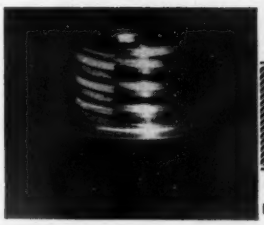

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Utah Scholarships Available

Three new four-year scholarships for sons of United States Smelting Refining and Mining Co. employes were announced in March by W. C. Page, general manager of western operations. The scholarships begin next fall in the University of Utah college of mineral industries. The Downey Davidson Muir Jr. scholarship in mining and geology, and the Walter Hazen Eardley scholarship, in nonferrous metallurgy, are available to sons of day wage employes who have completed five or more years at operations in Utah. Available to sons of salaried employes with a base salary not to exceed $400 a month, and with five or more years continuous service in Utah operations of the company, is the Edward Alexander Hamilton scholarship for study in either mining and geology or nonferrous metallurgy.

Howe Sound Plans Cobalt Refinery

The Howe Sound Co. of New York, is bringing into production an important cobalt source, the Blackbird mine near Salmon, Idaho. It is estimated that production will be in the neighborhood of 2,000,000 lb of cobalt a year. The ore from the mine will be treated at a new 2,000,000-lb capacity cobalt refinery near Garfield, Utah, construction of which is slated to start this summer. According to Harold H. Sharp, Howe Sound president, about 300 men will be employed at the mine and 30 will be employed at the refinery.

Sunshine Abandons Uranium Prospect

After carrying through on original plans on the New Enterprise group of claims of the Elkhorn Mining Co. near Boulder, Mont., the Sunshine Mining Co. has halted the project. Although some interesting samples were obtained, officials of the company state that further work does not seem justified at this time.

Camp B Explores Deeper Level

Stockholders of the Camp B Mining Co., at their annual meeting, authorized a program for additional exploratory work at the Camp B mine, located 11 miles northeast of Wickenburg, Ariz. As a result of their action, a station is being cut at the 400-ft level and a 90-ft drift will be driven under the known ore bodies. In addition, authorization was given for sinking the shaft another 100 ft to the 500-ft level. During the last nine months the shaft has been deepened from the 300 level.

Hillside Scene of New Uranium Minerals

The Hillside Mining and Milling Co., Hillside, Ariz., has increased its crew to 94 men, and currently is mining on the 800, 900, and 1000 levels. Production is running from 1600 to 1800 tons of lead, zinc, silver, copper ore monthly.

Underground working conditions have been improved considerably since the recent installation of ventilating equipment on the 1000 level.

The Hillside is the mine in which the discovery of three hitherto unknown uranium minerals was recently reported by Oscar L. Chapman, secretary, Department of the Interior.

According to the U. S. Geological Survey, the minerals were found in only one place in the mine as a one-eighth inch thick coating on gypsum 300 ft below the surface. The minerals were found in limited quantities, it was said, and may not have any particular economic value in the search for uranium used in atomic energy. Credit for first observing and collecting the three new minerals is given to Dr. Charles A. Anderson, geologist with the Geological Survey. They have been named andersonite, swartzite and bayleylite, honoring Dr. Anderson, Charles K. Swartz and William S. Bayley.

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982

Manganese Output

A steady production of manganese continues at the Boston Hill mine of the Luck Mining and Construction Co., near Silver City, N. M. Operations are directed by the owner, Mrs. Getrud Luck, and the daily shipments of ore are sent to the Colorado Fuel and Iron Co., Pueblo, Colo., for use in steel production.

Abe Reed Produces High Grade

Four carloads of high grade lead-silver ore have been shipped to the El Paso Smelter from the Abe Reed mine in the Aravaipa district of Arizona. It is being worked under bond and lease by Reed and White of Klondyke. The owner is Lon Rutledge of Box 133, Safford, Ariz.

Mining High

Production is scheduled to begin this summer at the Slate River silver mine atop 13,440-ft Treasury mountain near Crested Butte, Colo. In the summer of 1949 a road was built from the floor of Crystal basin to near the top of the mountain—rising 3400 ft in 10 miles—and a $100,000 aerial tramway 2100 ft long.

Keane Wonder Developments

Steady production of gold ore is planned at the Keane Wonder Extension property. Operators have completed a 4000-ft tramline, installed a compressor and other mining machinery and are sinking on a vein. The property adjoins the famous Keane Wonder mine in the old Skidoo district near Bishop, Calif.

Fluo-Solids Test

At the U. S. Bureau of Mines laboratory in Salt Lake City, a fluo-solids reactor is undergoing a series of comprehensive tests. Experimental work centers on roasting ores and concentrates including zinc concentrates, arsenical gold ores and the partial oxidization of cobalt ore.

Ideal Cement Will Expand

The Ideal Cement Co. will spend $3,500,000 to raise the capacity of its Trident, Mont., cement plant to 2,200,000 bbl a year, more than double the present rate. The announcement was made by Cris Dobbin, executive vice-president and general manager. First stage of the program will include addition of grinding facilities to increase capacity to 1,250,000 bbl. The rest of the plant program will consist of three stages to be completed in 1951, 1952 and 1953. The total projected capacity of 2,200,000 bbl a year is said to be greater than the demand that can be foreseen in the region for the next ten years.

AROUND THE WORLD WITH

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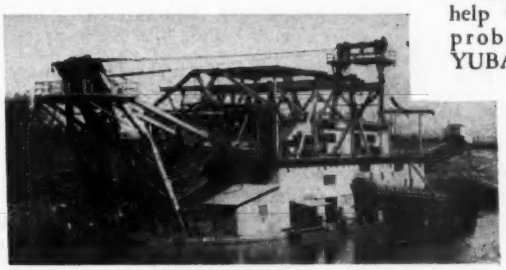
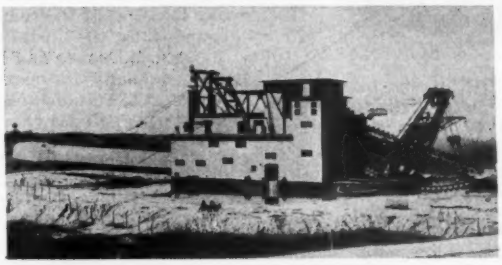
For over 40 years . . . a life-time of experience . . . YUBA has built dredges for the recovery of gold, tin, platinum, precious stones, and aggregate handling. Draw on this great fund of experience for help with your dredge problems — consult YUBA NOW.

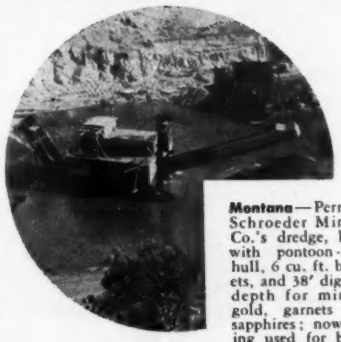


California — YUBA Dredge No. 98, with wood hull, 9 cu. ft. buckets, 30′ digging depth, recovering gold for La Grange Gold Dredging Co.

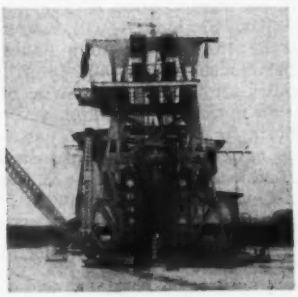


Korea — YUBA Dredge No. 79, steel hull, 10 cu. ft. buckets, 33′ digging depth, gold mining.

Yukon — Digging gold near Dawson for Yukon Consolidated Gold Corp. YUBA dredge with wood hull; designed for Arctic conditions. 7 cu. ft. buckets, 25′ digging depth.



Montana — Perry & Schroeder Mining Co.'s dredge, built with pontoon-type hull, 6 cu. ft. buckets, and 38′ digging depth for mining gold, garnets and sapphires; now being used for backfilling cofferdams at Canyon Ferry Dam site and for excavating aggregate.



Malaya — Kampar Malaya No. 1, with steel hull and 10 cu. ft. buckets, digging tin at depths to 75 ft. below water.

YUBA DREDGES

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Manufacturers Forum

Roof Bolting Drill

A new, all-hydraulic, roof-bolting drill has been announced by the Joy Mfg. Co., Pittsburgh 22, Pa. The drill employs boom feed and is self-leveling and self-aligning while drilling. This

machine, called the RBD-1, is reported to have an extremely high drilling speed where rotary-type drills are applicable.

Models of the self-propelled units are available in 26, 30 or 36-in. heights. Any model may be equipped for wet drilling or with vacuum dust remover, as desired. The electrically-powered machine is said to offer the advantage of permitting bottoming the maximum possible hole with only one steel change.

Euclid Establishes British Plant

The Euclid Road Machinery Co. is proceeding with its plan to establish a subsidiary, Euclid (Great Britain) Ltd. to manufacture Euclid earth-moving equipment in Great Britain. Manufacturing facilities in Glasgow, Scotland, are being leased from the British Government and operations will be started soon.

Initial production will concentrate on the 15-ton rear-dump hauler but other models will be built later. Practically all component parts of the 15-ton model will be manufactured in Britain to Euclid specifications.

A new regulation by the exchange control board of the Bank of England enables Euclid to withdraw in dollars the capital and all profits accruing at any time. Euclid was the first American company to receive approval for manufacture in England under this new ruling.

Lab Tests Aid Producers

Pyro-processing research conducted at Allis-Chalmers laboratories have spurred improvements in drying processes for phosphate slurries. One mining company which had for years been pumping a phosphate slurry back into the ground as waste material now finds it possible to dry the slurry and use the product for fertilizer. Pyro-processing has also shown promise for such processes as agglomerating magnetite and increasing the grindability of taconite. Recent research has shown that the grindability of taconite is improved when the rock is heated and then shock cooled.

Pilot plant facilities of the company will be expanded by the installation of a new ball mill, thickener and filter. It will have a capacity for crushing and grinding of 10 to 20 tons of either dry or wet material per day.

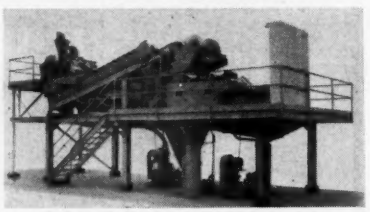
Adjustable Galvanometer

An adjustable blasting galvanometer that gives accurate resistance readings in ohms even when its activating cell is not at full strength, is now

available from the Atlas Powder Co. The new No. 4 blasting galvanometer is reported to provide extra safety and control in testing blasting circuits before firing. High accuracy is claimed for the instrument which is said to be able to check resistance of a single blasting cap.

Heavy Media for the Philippines

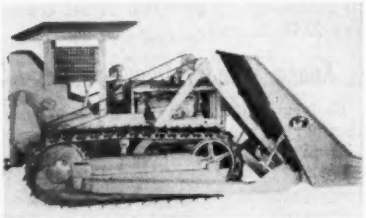
A complete Heavy Media plant built by Southwestern Engineering Co. of



Los Angeles has been sent to the Consolidated Mining Co., on Luzon, for use in concentrating chromite ore. Knocked down for shipment, the 28-ton unit will be conveniently shipped and ready for field erection in a matter of a few days after arrival at its destination. The plant has a capacity of 50 tons per hour. Similar units are furnished in sizes ranging from 10-200 tons per hour capacity and custom-designed plants are offered for larger capacity requirements.

Overshot Loader

A small overshot loader was recently added to the line of tractor-mounted loaders produced by John Austin, Inc.,



Denver. The new model 4-C unit has a capacity of one cu yd and a 20-sec loading cycle. It is made in two heights, for surface operation and for underground mining, respectively. The underground unit has an over-all height of 12 ft with bucket raised and a dumping clearance of 6 ft.

Pocket Slide Rule

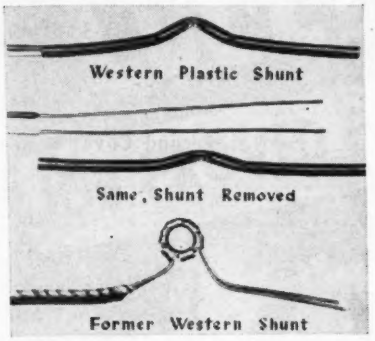
A new 5-in. log all-metal slide rule, bearing the identical scales of its 10-in. counterpart, has been announced by Pickett & Eckel, Inc., Chicago, Ill. The new slide rule has 22 scales arranged to provide the same power, speed and convenience of a 10-in. rule.

Flexible Ventilation Tubing

An improved type of light weight, flexible tubing for many uses is offered by Flexible Tubing Corp., Branford, Conn. "Spiratube" is said to be highly wear- and heat-resistant, portable, retractable, and easy to assemble. The tube is available in a variety of standard plys and materials, as well as in specially engineered combinations. Construction of the tubing is described as consisting of a rust-proof, spring-steel helical core, covered inside and out by double-seam stitched cotton duck, coated with neoprene.

Plastic Protects Cap Wires

A protective shunt is now available for all Western electric blasting caps according to an announcement from the explosives division of Olin Indus-



tries, Inc. A sleeve made of a non-conductive plastic is slipped over the bare ends of the leg wire, thereby minimizing possible corrosion due to atmospheric conditions. The wires remain bright and eliminate the need for scraping preparatory to wiring. Although the shunted wire is bent to prevent the sleeve from coming off prematurely, the shunt can be removed easily to leave the wires ready to be connected into the circuit.

Dust Control

A new engineering service is offered by the Johnson-March Corp. of Philadelphia to industries having dust problems or which use moisture penetration in their operations. The method is said to be applicable in coal mines to eliminate coal dust at working faces, tipples and dumps; in power plants to control dust in belt galleries and stockpile; in coal storage piles; and in crushing plants. The new service undertakes design and supervision of installation of liquid diffusion systems to meet the needs of any size operations.

Cap Lamps Boost Productivity

In a recent release, Mine Safety Appliances Co., Pittsburgh, Pa., stated that nearly half of the 300,000 gold miners who work within a 50-mile radius of Johannesburg are now equipped with Edison cap lamps. J. E. M. Hammond, manager of the company's African subsidiary firm, said that the native African miners are easy to train in the use of cap lamps but it requires a continuous educational program. "Many natives work only eight months in the mines, then return to their villages and buy wives with their earnings. When they need more cash for more wives, they go back to the mines. . . . Until Edison cap lamps were made available the South African miners used handheld carbide lamps which interfered with their productivity."

Rubber Pinch Valve

A rubber pinch valve, reported to be able to outwear metal when installed in pipelines carrying abrasive or corrosive mixtures, has been developed by the mechanical goods division of the U. S. Rubber Co. The flexible valve is designed to handle such materials such as pulverized coal, mine water, anthracite and bituminous screenings, and a large variety of other materials. Advantages claimed for the rubber valve are: flexibility to offset misalignment in pipes; the elimination of packing; the ability to absorb vibration; and reduced replacement costs as the valve's metal parts can be refitted to a new valve body.

— *Announcements* —

E. M. Platts, former sales vice-president of the **Joy Mfg. Co.**, was elected executive vice-president on May 10 to succeed the late **Arthur S. Knoizen**. Prior to joining the Joy staff in 1945, when the company acquired the La-Del Conveyor & Mfg. Co., Mr. Platts served the latter company as vice-president and his first position with Joy was as vice-president in charge of coal equipment sales.

Alfred Whittaker has been appointed Pacific Coast manager of the woven wire fabrics division of **John A. Roebling's Sons Co.**

Robert B. Moore has been appointed manager of the mining division of the **General Electric Co.'s** industrial engineering divisions. He succeeds **Russell S. Sage**, who plans to retire later this year.

George H. Deike, Jr., chief engineer and secretary, **Mine Safety Appliances Co.**, has been elected a director of the company.

C. Allan Fee has been elected secretary of the **American Car & Foundry Co.**, succeeding **Howard C. Wick**, who is retiring after 45 years of service with the company.

F. S. Nickerson has been elected vice-president of **Mack-International Motor Truck Corp.** and has been appointed manager of the central division sales territory.

Williams Deans, chief engineer, **I-T-E Circuit Breaker Co.**, has been elected vice-president in charge of engineering. **Gus E. Heberlein** has been named manager of the company's switchgear division.

CATALOGS AND BULLETINS

ACTUATING CYLINDERS. *Ledeen Mfg. Co., Los Angeles.* A large variety of pneumatic and hydraulic actuating cylinders for a wide range of uses are described in full in a 12-page catalog available on request.

BOTTOM DUMP HAULER. *The Euclid Road Machinery Co., Cleveland 17.* Improved features of the Model FDT bottom-dump Euclid are illustrated in Catalog No. 250, available on request. The new trailer hopper has been designed to shed wet and sticky material.

CHEMISTRY OF CYANIDATION. *American Cyanamid Co., New York 20, N. Y.* The Mineral Dressing Division has available "Mineral Dressing Notes" No. 7 presenting the fundamentals of cyanidation and zinc, copper and iron in cyanidation. The 40-page booklet, in the nature of a review, was presented before the Minerals Beneficiation Division of the AIME at the 1950 annual meeting.

CONVEYOR MINING. *Jeffrey Mfg. Co., Columbus 16, Ohio.* In a new and attractive catalog underground conveyors for face, room and entry work are fully described. Various units are illustrated and engineering data is supplied in detail. Methods of conveyor mining are illustrated in this 53-page booklet.

FLOTATION. *Hercules Powder Co., Wilmington, Del.* A new technical booklet on flotation and flotation reagents including a discussion of the process, reagents, and formulas illustrating some of the methods employed that aid in controlling ore-dressing mill operations. Examples of actual practice add to the value of this useful bulletin.

LOADING MACHINES. *Myers-Whaley Co., Knoxville, Tenn.* A complete and graphic story on loading machines is presented in the company's Catalog No. 250. Details and specifications are presented for all models of Whaley "Automat" underground shovel-action loaders claimed to be equally effective in coal, rock and ore loading.

MOBILE COAL DRILLS. *Joy Mfg. Co., Pittsburgh 22, Pa.* Seven self-propelled coal drills for high speed operation are described in a new 12-page bulletin that furnishes complete specifications on every model.

ROD MILLS. *Hardinge Co., Inc., York, Pa.* Revised information on rod mills for grinding and pulverizing has been published in Bulletin No. 25-B. The new type convex-head rod mill as well as the standard conical-ended rod mill are described along with details of typical installations.

RUBBER LINED PUMPS. *Allis-Chalmers Mfg. Co., Milwaukee.* A new bulletin entitled "SRL Rubber-Lined Pumps" describes various pumps of this type that have been manufactured by Canadian Allis-Chalmers, Ltd., for over 15 years. A new unit of an extensive line handles liquids with solids ranging from particle sizes of 325 mesh to ⅛ in. This pump was especially developed to handle pulps encountered in milling and concentration of ores.

SPIRAL OPERATION. *The Humphreys Investment Co., Denver.* A manual of operating instructions, Bulletin No. 10, for the Humphreys Spiral concentrator closed circuit test unit is available on request. Full information is given on the theory of spirals and its manner of operation. Testing methods are described in detail and examples are presented.

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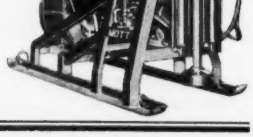

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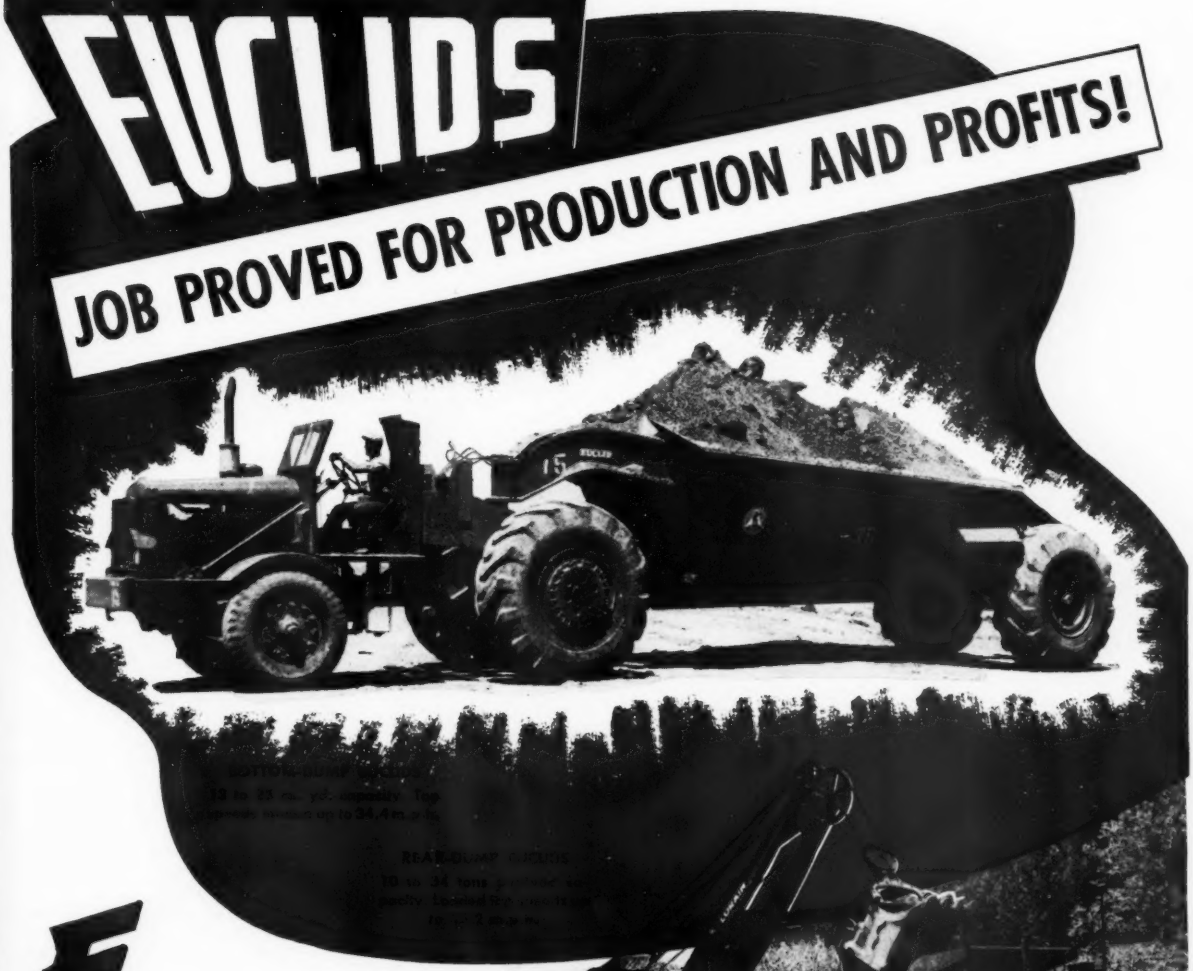

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Owners prefer Euclid equipment for its efficiency and dependability under a wide range of operating conditions. Long service life combined with low operating and maintenance costs result in more profits and less down time. Operators prefer "Eucs" for their ease of handling, riding comfort, and positive control on soft fills and rough haul roads.

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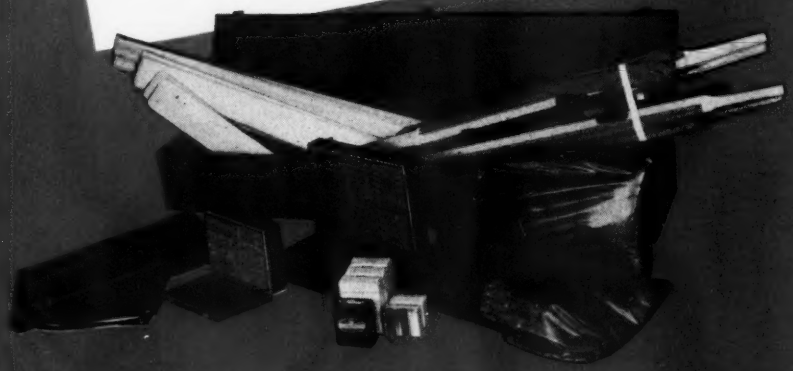
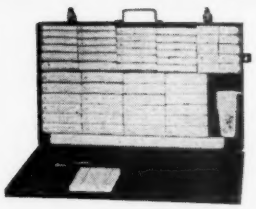


M·S·A EMERGENCY FIRST AID OUTFIT

Especially adapted for easy transportation in the mine and for storage at the working face, this equipment is a complete emergency outfit in a durable steel case. The contents include a folding stretcher which opens quickly to full-size army type, two complete first aid kits, blankets, splints, and Redi-Heat Blocks. The sturdy 20-gauge steel case is equipped with an extra heavy, tight-fitting lid and a rubber gasket which keeps contents dry and free from dust and mildew. The case is furnished with strong handles at both ends and a bracket for horizontal mounting. Overall dimensions, 56" x 12⅝" x 8". Write for Bulletin 103.

. . . and for First Aid Training THE M·S·A CONTEST OUTFIT

A complete unit of equipment for first aid training and contests, this outfit provides the complete list of materials recommended by the U. S. Bureau of Mines for first aid practice and contest work, contained in a strong steel box which is easily transported. The box, which is finished in white, is made of 24-gauge steel, and is equipped with a strong handle at each end. The M. S. A. Contest Outfit aids neatness and efficiency, prevents loss of materials. Write for details!



M·S·A MINERS FIRST AID CABINET

This completely-equipped cabinet contains a large assortment of first aid materials and supplies meeting the needs of mine hospitals or dressing stations. The contents conform to materials recommended by the United States Bureau of Mines for first aid treatment. The sturdy steel case is designed for wall mounting, or transportation when required. Bulletin FA-74.

M·S·A ALL-WEATHER FIRST AID KIT

Providing dependable protection against dust, dirt and moisture for assortments of unit-packaged first aid materials, M. S. A. All-Weather First Aid Kits feature strong steel cases with replaceable rubber gasket which seals edges tightly when kits are closed. The unit packages contain one or more treatments for single injuries without waste. Kits are available in 10-, 16-, 24-, and 36-unit sizes. Bulletin FA-101.

M·S·A REDI-HEAT BLOCK

Using replaceable Redi-Heat charges, this unit provides quick, safe emergency heat for first aid applications. Always ready for immediate use, the M. S. A. Redi-Heat Block employs no liquids. The charges are unaffected by external conditions and have unlimited storage life. Bulletin FA-92.

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